Outgoing
M0350002
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State of Utah
DEPARTMENT OF NATURAL RESOURCES

MICHAEL R. STYLER
Executive Director

Division of Oil Gas and Mining

JOHN R. BAZA
Division Director

JON M. HUNTSMAN, JR.
Governor

GARY R. HERBERT
Lieutenant Governor

Supervisor DRH

Inspection Report
Minerals Regulatory Program
Report Date: November 1, 2007

Mine Name: **Bingham Canyon Mine**
Operator Name: **Kennecott Utah Copper**
Mr. Rohan McGowan-Jackson, Manager
8362 West 10200 South
Bingham Canyon, Utah 84006
Permit number: M/035/002
Inspection Date: 10252007
Time: 9:00 AM
Inspector(s): Ms. Beth Ericksen
Other Participants: Mr. Goeff Bedell, Mr. Chris Kaiser, Ms. Vicky Peacey (all participants from KUC)
Mine Status: Active
Weather: partly sunny, 80°

Elements of Inspection	Evaluated	Comment	Enforcement
1. Permits, Revisions, Transfer, Bonds	☐	☐	☐
2. Public Safety (shafts, adits, trash, signs, highwalls)	☐	☐	☐
3. Protection of Drainages / Erosion Control	☐	☐	☐
4. Deleterious Material	☐	☐	☐
5. Roads (maintenance, surfacing, dust control, safety)	☐	☐	☐
6. Concurrent Reclamation	☒	☒	☐
7. Backfilling/Grading (trenches, pits, roads, highwalls, shafts, drill holes)	☐	☐	☐
8. Water Impoundments	☐	☐	☐
9. Soils	☐	☐	☐
10. Revegetation	☐	☐	☐
11. Air Quality	☐	☐	☐
12. Other	☒	☒	☐

Purpose of Inspection:

The purpose of the inspection was to view the reclamation activities that have taken place during 2007. According to the terms of the reclamation contract and the Mining and Reclamation Plan, KUC is required to maintain a program of reclamation experimentation. For the year KUC has implemented a seeding technology referred to as VAM-GRO on about 10 acres in the Highland Boy area of Zelnora. In addition, the 5990-ft elevation site was included as part of the KUC reclamation activities for the year as well as initiating work at the 6190-ft level.

1594 West North Temple, Suite 1210, PO Box 145801, Salt Lake City, UT 84114-5801
telephone (801) 538-5340 • facsimile (801) 359-3940 • TTY (801) 538-7458 • www.ogm.utah.gov

UTAH DNR OIL, GAS & MINING

File in:
☐ Confidential
☐ Shelf
☒ Expandable
Refer to Record No 0026 Date 11-1-07
In M/035/002, 2007, Incoming
For additional information

Inspection Summary:

Elements of Inspection, #'s 6, and 12 have specific comments about each element in the sections below.

Highland Boy area: The Zelnora area of this location received several hundred plantings in May 2007 under the VAM-GRO experimental technology program for the year 2007. Plantings were randomly placed and consisted of 764 plants: 225 Aspen, 191 Common Chokecherry, 184 Mountain Mahogany, and 164 Utah Serviceberry. An outside firm has evaluated success results.

Coupled with the VAM-GRO plantings were 1336 Big Mountain Sagebrush and 1060 Mountain Mahogany.

A water collection system is being installed in this area, consisting of a surface impoundment. There is plenty of volunteer vegetation in this area, however, unsure of the number of species.

Queen area: Re-grading has not occurred at this site for the year 2007. The plan is to start re-grading the slope once Lower Bingham Canyon is finished. Estimated year is 2009.

5990 Level: This area is near completion and seedlings/seed were being planted on the day of the site visit and were to continue through 27 October. This area will have 2153 Mountain Mahogany and 1847 Scrub Oak.

Conclusions and Recommendations:

Reclamation activities regarding the Bingham Canyon Mine Waste Rock Disposal Area were on task and as generally outlined in the outline of KUC's Reclamation Activities Plan for 2007. The Division would like information on: the outcome of the VAM-GRO study for each of the varieties of species planted and plans for the future.

Inspector's Signature BE **Date:** 11.03.07

BE:pb

cc: Mr. Chris Kaiser, Kennecott Utah Copper, KAISERC@KENNECOTT.COM

Enclosure: Photo PICTURE PAK (6)

File in:
- ❑ Confidential
- ❑ Shelf
- ❑ Expandable

Refer to Record No________ Date________
In Permit#________, _______, ___________
For additional information

10.25.07

VAMGRO TWO

10-25-01


HIGHLAND BOY AREA

10-25-07

ZELNORA - HIGHLAND BOY AREA
WATER COLLECTION SYSTEM

10.25.07

10.25-07

M0350002- Incoming

RECEIVED
SEP 1 1 2007
9/17
DIV. OF OIL, GAS & MINING

Kennecott Utah Copper Corporation
12000 West 2100 South
P.O. Box 6001
Magna, Utah 84044-6001
Tel: (801) 569-6356
Fax (801) 569-7192

Rohan McGowan-Jackson
General Manager, HSEQ

Kennecott Utah Copper
A member of the RIO TINTO Group

September 11, 2007

Ms. Mary Ann Wright
Division of Oil, Gas and Mining
1594 West Temple, Suite 1210
Salt Lake City, UT 84114

Subject: Kennecott Utah Copper Notice of Violation No. N2007-58-01

Dear Mary Ann:

This letter is submitted as a follow-up to the informal conference between representatives of the Division and Kennecott on August 31, 2007 regarding resolution of the above-referenced NOV. This letter has two purposes: First, to seek an extension of the current time periods for the abatement measures contained in the NOV, which will allow adequate time for the parties to advance to the next step in their efforts to resolve the NOV, and second, to provide additional information to the Division consistent with our discussions at the conference.

Time Extension

With regard to the first item, it is Kennecott's understanding that the abatement time periods in the NOV, as extended for three weeks by the Division (email correspondence, Rohan McGowan Jackson and Mary Ann Wright, August 21, 2007), are as follows:

- Items 3a & 3b: September 13, 2007 (i.e., original 15 days plus 21 day extension equals 36 days total, begin counting days on August 9th (see R641-105-800(day of the act, event or default not included when determining time periods))).
- Items 1, 2, 3 & 4: October 15, 2007 (i.e., original 45 days plus 21 day extension equals 66 days total, which ends on a weekend (Saturday Oct. 13th), and therefore carries over till the next Monday (Oct. 15).

Kennecott requests that the abatement periods for all of the items (1, 2, 3, 3a, 3b, 4) be extended **until October 31, 2007**, which should give the parties time to advance their discussions and hopefully resolve the NOV. For the Division's information, Kennecott plans to submit to the

Division, by Oct 10, 2007, a proposal for resolution of the NOV, well in advance of the end of the requested extension.

Additional Information

Pursuant to our discussions at the conference, and in order to provide a more complete factual context for our discussions, Kennecott is submitting the following information with this letter:

- A copy of the package that was submitted to the Division by Kennecott for the "Code 22" operations at the Bingham Mine, which included an updated version of the reclamation map (Figure 4-6 (R3)) contained in the 2003 Reclamation and Water Management Plan showing the planned Code 22 operations. (**Attachment 1**) This package was previously submitted on January 24, 2007. (The original submittal included a large format version of the map. If the Division cannot locate that map, we will provide another copy.)

- A copy of the Division's letter to Kennecott, dated February 1, 2007, stating that the Division was incorporating "Code 22" operations into Kennecott's Reclamation and Water Management Plan. Kennecott's records also indicate Division staff conducted a site tour of the "Code 22" area on February 9, 2007 and provided verbal approval to proceed with waste placement in the "Code 22" area.[1] (**Attachment 2**)

- A copy of the stability analysis of all Kennecott waste disposal areas that was performed by Call and Nicholas, Inc. in 2004, along with a cover letter from Kennecott to the Division (August 16, 2004) which summarized and attached this analysis. **(Attachment 3)** Since submittal of this study Kennecott has been proactively evaluating and implementing recommendations of the study such as surface water control, dump monitoring and best practice active dump placement.

- Calculations detailing the capacity of the Yosemite drainage runoff control system facilities. **(Attachment 4)**

- Kennecott is also providing those portions of the specifications, plans and drawings addressing the Yosemite drainage that are incorporated in the April 1996 Eastside Collection Monitoring Network Ground Water Discharge Permit Application (referenced in Part II.E. of the associated DWQ groundwater permit (Permit No. UGW350010)). (**Attachment 5**).

- Supplemental to Attachment 5 Kennecott is also providing construction drawings related to the above project that further illustrate the Yosemite runoff management facilities (**Attachment 6**). (Note that Figure 450-C-1378 refers to management practices in Castro Gulch; that figure is appended since the Castro Gulch practices served as a template for implementing similar management conditions in the Yosemite drainage).

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[1] As you know, it is Kennecott's position that operations like Code 22, which are within the Bingham Mine permit area and are consistent with the 1976 Reclamation Plan, do not require Division approval.

- The following description of the actions Kennecott has taken to date in the wake of the discharge of sediment-laden water down the Yosemite drainage in connection with the July 26/27th storm event, as relevant to the affirmative actions in the NOV:

  1. Identify appropriate and additional measure(s) to avoid or minimize future damage to natural channels.

  - Item 1 of NOV: There was little if any "damage" to "natural channels" as a result of the subject discharge. The Yosemite drainage arguably becomes "natural" below the Eastside Collection system cutoff wall. The only change in condition of the drainage below that point was the deposition of a thin layer of sediment in stretches of the drainage that are normally dry, which left the vegetation essentially unaffected. There was no down cutting or other erosion damage. The issue of additional measures to avoid or minimize future flows of sediment-laden water in the Yosemite drainage will be addressed in the settlement proposal Kennecott is preparing for submission to the Division.

  2. Provide detailed erosion control designs for all erosion control structures to show sediment is being controlled, contained and treated in the Butterfield Canyon area. Optimize these designs.

  - Item 2 of NOV: Information regarding the design of the storm water control systems below the toe of the Yosemite dump is provided as part of this letter to the Division (Tab A). Potential optimization of the storm water system will be addressed in the settlement proposal Kennecott is preparing for submission to the Division.

  3. Demonstrate how deleterious materials (sediment) will be kept in an isolated condition to minimize or prevent any physical or chemical conditions in the soils and/or water so that environmental effects are adequately controlled. Establish and submit an implementable sediment-sampling plan before relocating sediment materials that meets Division approval.

  - Item 3 of NOV: The first sentence in Item 3 will be addressed in the settlement proposal Kennecott is preparing for submission to the Division.

    With regard to the second sentence, Kennecott took samples of the offsite sediment as described in the August 8, 2007 letter that was submitted to DWQ, to the Division of Environmental Response and Remediation, and to the Division. (As discussed at the conference, these sample results were not available to the Division when it wrote the NOV.)

    In addition, consistent with its normal sediment basin clean-out practice, Kennecott removed the sediment that collected in the Yosemite sediment basin (i.e., the structure located upgradient of the Yosemite cutoff wall and basin) following the storm event. This material was transported to the Copper Notch area, where it was end dumped in a discrete area on the flat to the west of the SJEP/Bastian Sink material. Kennecott plans to push this material to the west and deposit it on the outslope of the Keystone dump, which is comprised of unreclaimed sulfidic waste rock material. While Kennecott does not normally sample the sediment that it periodically cleans from the sediment basins and places on the waste rock outslopes, Kennecott is willing to sample the end dumped material for suitability as growth medium if the Division believes there would be value in such an exercise. Based on the origin of the material, Kennecott thinks it is very unlikely to be suitable for growth medium.

Kennecott has also cleaned dried sediment and mud from the county road and at the location where the sediment laden water crossed the road prior to entering Butterfield Creek. Efforts to remove dried sediment from the culvert under the county road are ongoing. That material was also placed at Copper Notch, in the same area as the material from the sediment pond. As documented in prior post-event reports by Kennecott, in the perennial reach of Butterfield Creek there is no visible sediment in the creek channel with the exception of a short stretch below the point where the storm water entered the creek at the plugged culvert, where some sediment material is visible in interstitial gaps in the rock substrate. Any attempt to remove such material would cause significant damage to the stream bed, and so Kennecott currently does not plan to do so.

Except as noted above, Kennecott currently does not plan to remove or relocate any additional sediment material, although we continue to work with Mr. Dansie with respect to the thin (1/4") layer of sediment deposited on a part of his field. (As discussed at the conference, this material is within agricultural and residential limits for this area of the valley, and is likely to have lower lead concentrations than the existing soils.) We expect that our current plans regarding sediment removal and sampling will be the subject of the ongoing settlement discussions with the Division.

3a. Any sediment/debris that flowed outside of the permit area shall be cleaned up and removed to a Division approved location.

3b. Identify where the removed sediment has been deposited and commit to remove the material to a Division-approved site if it is determined (through sampling) to adversely affect plant growth and/or water quality.

- <u>Items 3A & 3B of NOV</u>: See the above discussion regarding Item 3.

4 Commit to establishing stability analysis plans for the waste dump area(s) that contribute to Butterfield Canyon watershed. Determine an appropriate slope stabilization method for all waste dumps contributing to Butterfield Canyon area (which may include reducing the angle of repose of the dump slope).

- <u>Item 4 of NOV</u>: At the conference, Kennecott informed Division staff that a waste rock stability study had been prepared by Kennecott in 2004 as a follow-up item to the 2003 Water Management and Reclamation Plan, and had been reviewed at that time by the Division. We understand the Division has now located a copy of the study in its files and we've supplied an additional copy with this letter (**Attachment 3**). This study has obvious relevance to Item 4, and so we expect it will be a subject that will be further discussed as we move forward with efforts to resolve the NOV.

We appreciate the Division's consideration of Kennecott's extension request and hope the information provided as attachments to this letter will help further our settlement discussions. We look forward to working with the Division to find a mutually acceptable path forward to resolve NOV No. N2007-58-01. If you have any questions regarding this submittal, please contact me directly.

Sincerely yours,

for Rohan McGowan-Jackson
General Manager, HSEQ

RMJ\MM: kg

Enclosures

CC: Daron Haddock
Susan White

Attachment 1 – Kennecott January 24, 2007 Letter Regarding Code 22 Waste Rock Emplacement

Kennecott Utah Copper Corporation
P.O. Box 6001
Magna, Utah 84044-6001
(801) 569-6000

(801) 569-6356 (Phone)
(801) 569-7192 (Fax)

Rohan McGowan-Jackson
Manager, Health, Safety & Environmental
and Sustainable Development

Kennecott
Utah Copper
A member of the RIO TINTO Group

January 24, 200~~6~~7

Mary Ann Wright
State of Utah
Department of Natural Resources/DOGM
PO Box 145801
Salt Lake City, UT 84114-5801

<u>Ongoing Activity: Code 22 Waste Rock Emplacement</u>

Dear Mary Ann,

As you know, I am eager to ensure that KUC continues to provide DOGM with relevant information associated with ongoing activities and that this information is provided in a manner that allows DOGM to easily update exiting records.

In this regard, the purpose of this correspondence is to provide you with information regarding KUC's intention to place overburden in an area called Code 22.

Code 22 is located on the eastern side of the Bingham Canyon Mine and is planned to contain approximately 35 million tons of waste rock. Code 22 waste rock will be largely placed on top of existing waste rock dumps and disturbed areas within the mine.

KUCC is of the opinion that this activity is within the approval envelope associated with our existing NOI and therefore should not be considered as an amendment. However, I understand from previous discussions that DOGM's preference is to receive information regarding ongoing activities via Form MR-REV.

As such, I am submitting with this letter a Form MR-REV with relevant information attached regarding KUC's proposed Code 22 waste rock disposal area. However, submission of this form should not be construed as an admission on KUC's part that KUC is required to obtain DOGM approval for this activity.

Consistent with this position, the following information is attached for your files:

1. <u>FORM MR-REV: Information for the Bingham Canyon Mine, Code 22 Waste Rock Disposal Area (M/035/002)</u>

Please see attached an updated version of Figure 4-6 Reclamation Activities on Bingham Canyon Mine Waste Rock Disposal Areas.

This updated figure (Figure 4-6 (R3)) includes information associated with the expected location of additional overburden material to be placed at Code 22, in addition to the proposed re-grade toe. KUC suggests that the attached Figure 4-6 (R3) replaces the existing Figure 4-6 within the Bingham Canyon Mine 2003 Mine Reclamation and Water Management Plan.

KUCC does not expect that this activity will adversely impact any of the reclamation treatments defined in the Bingham Canyon Mine 2003 Mine Reclamation and Water Management Plan. KUCC will work to salvage top soil or growth media from the Code 22 area which may provide additional opportunities to extend existing approved treatments. The volume of top soil and growth media will be better understood once salvage activities have been completed.

Please contact me or Vicky Peacey if you have any questions about this proposed activity.

Kind regards,

R. McGowan-Jackson

Rohan McGowan-Jackson
Manager HSE & SD
Kennecott Utah Copper

cc: Vicky Peacey
Bruce Jones

FORM MR-REV

INFORMATION FOR THE BINGHAM CANYON MINE, CODE 22 WASTE ROCK DUMP

PERMIT M/035/002

KENNECOTT UTAH COPPER CORPORATION

SUBMITTED TO
THE UTAH DIVISION OF OIL, GAS AND MINING
JANUARY 2007

I. GENERAL INFORMATION

Location of Proposed Activities:

There are no changes to the location of proposed activities.

Ownership of Land Surface:

There are no changes to ownership of land surface.

Ownership of Minerals:

There are no changes to ownership of minerals.

II. MAPS, DRAWINGS & PHOTOGRAPHS

Figure 4-6

Figure 4-6 within the Bingham Canyon Mine 2003 Reclamation and Water Management Plan for DOGM permit M/035/002 is a map of the waste rock disposal area showing the tentative reclamation activities that are currently planned. Figure 4-6 has been updated (Figure 4-6 (R3)) to include information associated with the expected location of overburden material for the Code 22 waste rock dump. Figure 4-6 (R3) is contained within Appendix 1 of this document.

III. OPERATION PLAN

The total number of acres affected and permitted disturbed acreage remains consistent with the original 1976 NOI, 1978 Mining and Reclamation contract as well as the 2003 Reclamation and Water Management Plan. All activities associated with the Code 22 waste rock dump will occur within permitted disturbance areas as a continuation of open pit mining and waste rock disposal operations similar to activities being conducted for the past one hundred years.

There will be no major changes to the operating plan, as KUCC will continue to operate open pit mining, removing ore and placement of waste rock on top of existing waste rock dumps.

The waste rock dump will hold approximately 35 M tons and will be largely placed on top of existing waste rock dumps in the area. The footprint of the dump will cover approximately 100 acres and once re-graded it will cover an additional 20 acres. In total approximately 23 acres of non-waste rock areas will be impacted after re-grading, however these areas already contain some degree of disturbance due to existing roads and berms constructed prior to 1960.

KUCC's general plans regarding the reclamation treatments for waste rock dumps will not change substantially as a result of this activity. As noted on Figure 4-6 in the

Bingham Canyon Mine 2003 Reclamation and Water Management Plan, all contacts and surface areas are approximate and are subject to change based upon changes in the mine plan. The same conditions will apply to Figure 4-6 (R3) due to the dynamic nature of mining operations.

The 2003 plan also specifies that future mine plans call for the placement of one billion additional tons of waste rock before closure that will be placed on top of lifts on top of existing waste rock disposal areas. The plan mentions that the total area of waste rock disposal over native ground may increase by approximately 200 acres. As described in the plan, the actual acreage and boundaries of the various reclamation treatments may be modified in response to changes in the mine plan. The placement of waste rock at Code 22, will largely be on top of existing waste rock disposal areas and is still consistent with text within 2003 plan.

Appendix 2 contains a completed "Application for Mineral Mine Plan Revision or Amendment" form showing items that should be replaced within the Bingham Canyon Mine 2003 Reclamation and Water management Plan.

IV. IMPACT ASSESSMENT

The placement of Code 22 is simply a continuation of open pit mining and optimization of waste rock placement and haulage profiles. Code 22 will not produce any additional surface or subsurface impacts on the following areas:

1. No potential impacts to state or federal threatened and endangered species or critical habitats since the large majority of waste rock will be placed on lifts within existing disturbed areas;

2. There will be no additional impacts to surface or groundwater systems beyond the impacts that already exists and which KUCC is addressing from historic operations. The Code 22 waste rock dump will not impact the current source control or remediation activities for the protection of groundwater resources. All waste rock will be placed up gradient of the Yosemite cut off wall.

3. The Code 22 waste rock disposal area may impact up to 23 (includes regrade portion) acres of non-waste rock areas. KUCC will salvage growth media and/or top soil from these areas for future reclamation use prior to waste rock placement and re-grading.

4. The Code 22 waste rock dump will not further impact public health or safety or air quality. The Code 22 waste rock disposal area will remain within the limits of the Bingham Canyon Mine air quality approval order (DAQE-AN0571018-06). The Code 22 waste rock will not further degrade surface erosion or slope stability. The dump will contain a maximum dump height of 300 feet with adequate setbacks to allow for ease of re-grading to a maximum slope of 2.5:1 with the addition of water catch basins or benches to reduce surface erosion.

5. KUCC believes there will be no addition impacts to mitigate beyond the current situation.

V. RECLAMATION PLAN

Waste rock will be largely placed on top of existing waste rock dumps. KUCC continues to plan reclamation treatments consistent with Figure 4-6 (R3). In addition top soil and growth media will be salvaged from native hillsides prior to waste rock disposal and re-grading.

Updates to Figure 4-6 show Code 22 waste rock placement. Placement of the dump and the ultimate re-grade toe are approximate and the final extent and configuration may change slightly throughout the life of mine.

VI. VARIANCE

KUCC is not requesting a variance.

VII. SURETY

The proposed activities will not result in a substantial change in the amount of work required to complete reclamation.

APPENDIX 1

Figure 4-6 (R3)

KENNECOTT UTAH COPPER CORPORATION

SUBMITTED TO
THE UTAH DIVISION OF OIL, GAS AND MINING
JANUARY 2007

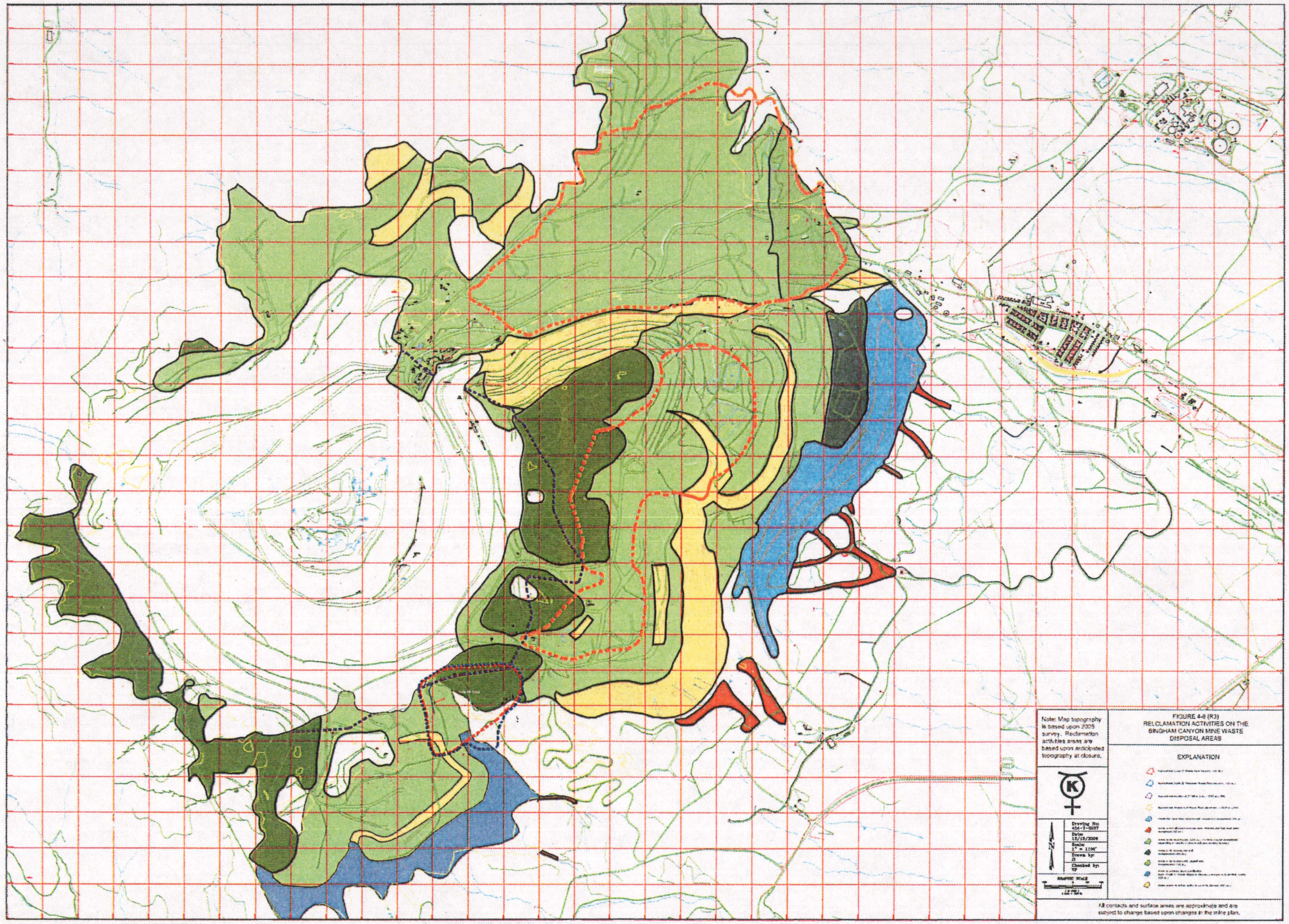

FIGURE 4-8 (R3)
RELCLAMATION ACTIVITIES ON THE BINGHAM CANYON MINE WASTE DISPOSAL AREAS

APPENDIX 2

Application for Mineral Mine Plan Revision or Amendment
Code 22 Waste Rock Disposal Area

KENNECOTT UTAH COPPER CORPORATION

SUBMITTED TO
THE UTAH DIVISION OF OIL, GAS AND MINING
JANUARY 2007

Form MR-REV-att (DOGM – Revise/Amend Change Form)
(Revised September 14, 2005)

Application for Mineral Mine Plan Revision or Amendment

Operator: Kennecott Utah Copper	
Mine Name: Bingham Canyon Mine	**File Number:** M/ 035 / 002

Provide a detailed listing of all changes to the mining and reclamation plan that will be required as a result of this change. Individually list all maps and drawings that are to be added, replaced, or removed from the plan. Include changes of the table of contents, section of the plan, pages, or other information as needed to specifically locate, identify and revise or amend the existing Mining and Reclamation Plan. **Include page, section and drawing numbers as part of the description.**

DETAILED SCHEDULE OF CHANGES TO THE MINING AND RECLAMATION PLAN

			DESCRIPTION OF MAP, TEXT, OR MATERIALS TO BE CHANGED
□ ADD	XX REPLACE	□ REMOVE	Figure 4-6 with Figure 4-6 (R3) in Appendix 2
□ ADD	□ REPLACE	□ REMOVE	
□ ADD	□ REPLACE	□ REMOVE	
□ ADD	□ REPLACE	□ REMOVE	
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I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments and obligations, herein.

Rohan McGowan-Jackson
Print Name

Position: Manager, Health, Safety and Environment & Sustainable Development

R. McGowan-Jackson
Sign Name, Position

1/3/07
Date

Return to:

State of Utah
Department of Natural Resources
Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
Box 145801
Salt Lake City, Utah 84114-5801
Phone: (801) 538-5291 Fax: (801) 359-3940

FOR DOGM USE ONLY:
File #: M/ /
Approved:
Bond Adjustment: from ($)
to $

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Attachment 2 - Division February 1, 2007 letter regarding “Code 22” Waste Rock Emplacement

State of Utah

Department of Natural Resources

MICHAEL R. STYLER
Executive Director

Division of Oil, Gas & Mining

JOHN R. BAZA
Division Director

JON M. HUNTSMAN, JR.
Governor

GARY R. HERBERT
Lieutenant Governor

February 1, 2007

Kennecott Utah Copper Corporation
Rowan McGowan-Jackson
P.O. Box 6001
Magna, Utah 84044-6001

Subject: Modifications to the Bingham Canyon Mine Reclamation and Water Management Plan, Kennecott Utah Copper Corporation, Bingham Canyon Mine, Task # 1668 & 1681, M/035/002, Salt Lake County, Utah

Dear Mr. McGowan-Jackson:

On December 21, 2006, the Division received your letter outlining recent activities at the Bingham Canyon Mine. These activities included information concerning the Giant Leap pushback in the pit, waste rock placement from this additional mining, and updated tables reflecting Kennecott's demolition progress. The Giant Leap and subsequent waste rock placement are new information that will be incorporated into Kennecott's reclamation plan. Building demolition was a part of the approved reclamation plan and will be treated as such.

On January 26, 2007, the Division received additional information which outlined an expansion of the Code 22 waste dump area. This additional waste dump disposal area will be needed for a portion of the waste material produced as a part of the Giant Leap mining.

This additional dump area has been projected to cover approximately 120 acres after reclamation. In actuality the total area impacted by dumps at the mine will only expand by 23 acres. The remainder of the area covered by the dump will be located on areas presently covered by waste dumps. Portions of this 23 acre area has been previously impacted by roads and mining related activities. Growth medium will be stripped from this area and stockpiled for use in future dump reclamation.

A portion of the area to be impacted by this proposed dump is identified as containing material sufficiently oxidized to allow for revegetation. Before this area can be impacted by the proposed waste dump, this oxidized material needs to be harvested for use during future reclamation. The map submitted with the Code 22 proposal needs to be revised to show where this material will be stored until it can be used for reclamation. Please resubmit two copies of the corrected map to show these changes.

The Division will incorporate these plan modifications into Kennecott's Bingham Canyon Mine Reclamation and Water Management Plan. We appreciate Kennecott's efforts in keeping us apprised of activities at the site and keeping the mining and reclamation plan updated. Please continue to communicate these changes to allow the Division to have a better overview of the activities at the site. We will schedule a tour of the mine in the near future to look at these areas in the field.

We would like to request that Kennecott furnish a second copy of these plans. The Division normally requires two copies of proposed changes. Two copies are need so that one copy can be stamped approved and returned to the operator and the other will be integrated into your approved reclamation plan. If you have any questions, please contact me at (801) 538-5258 or Doug Jensen at (801) 538-5382.

Sincerely,

Daron R. Haddock

for Susan M. White
Mining Program Coordinator
Minerals Regulatory Program

SMW:dj:pb
cc: Vicky Peacey w/o enclosure
P:\GROUPS\MINERALS\WP\M035-SaltLake\M0350002-BinghamPit\final\01302007apl-ltr.doc

Attachment 3 - August 16, 2004 Kennecott Submittal Including Slope Stabilization Study

Kennecott Utah Copper Corporation
P.O. Box 6001
Magna, Utah 84044-6001
(801) 569-6000

(801) 569-7120 (Phone)
(801) 569-7192 (Fax)

Paula H. Doughty
Director, Environmental Affairs

Kennecott

August 16, 2004

CERTIFIED MAIL
Mr. Daron Haddock, Permit Supervisor
Minerals Reclamation Program
Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
PO Box 145801
Salt Lake City, Utah 841114-5801

Dear Mr. Haddock:

Subject: Results of Kennecott Utah Copper Corporation Slope Stabilization Study for Permit Number M/035/002

Attached with this letter is a report containing the results of a slope stabilization study performed on all the Kennecott Utah Copper Corporation (KUCC) waste disposal areas and a reclamation design and cost estimate for the South End waste disposal areas. Agreement on the scope of this study was reached by members of your staff through approval of the Bingham Canyon Mine 2003 Reclamation and Water Management Plan (Permit Number M/03/002) via correspondence received on June 11, 2003. As part of that plan, KUCC agreement to perform a slope stabilization study by March 2005.

SLOPE STABILIZATION STUDY

Although the original slope stabilization study was to be performed on only the southeast margin of the waste rock disposal areas, known as the Butterfield and/or South End waste rock piles, the stability study encompassed all of the Kennecott Utah Copper Corporation (KUCC) waste rock.

The primary risks considered in this study included shallow surface slumps and debris flows, deep seated large-scale failure, and acid rock drainage (ARD). Dr. Call from Call and Nicholas Inc. out of Tucson, Arizona, was contracted to complete the study. Dr. Call stressed the operational slope stability risk associated with high finger dumps constructed at a rapid rate of advance, the risk of small and large scale contaminated water and sediment release from shallow slumps and debris flows following rain events, along with recommendations on overall geotechnical and geochemical (ARD) implications related to slope reduction and stabilization.

No critical risks were identified, however two "likely" risks with "moderate" consequences were noted including:

- Operational risks associated with shallow slumps and debris flows from high finger dumps constructed at a rapid rate of advance for the dumps in Bingham Canyon
- Shallow slumps and debris flow from South End dumps following severe rain events flowing off KUCC property

Dr. Call's report also mentioned, that although the probability of ARD breaching the cut off wall system and flowing into the Salt Lake Valley aquifer is "unlikely", the consequence would be "very high". Thus, Dr. Call stresses maintenance of the cut off wall collection system.

There was only one risk identified with a "high" consequence:

- Major haulage of dump material and increased ARD and erosion by regrading the East Dumps due to a new environmental requirement.

This activity would have a high consequence and negative environmental impact since the disturbed East dump material would extend beyond the cut off wall system and would result in increased production of ARD. The risk level was addressed as a critical comment and a likelihood rating was not assigned since the hazard is political rather than geotechnical.

Some unlikely risks were also identified with a "low" to "moderate" consequence. All findings and recommendations are thoroughly summarized in Dr. Call's report (Attachment A).

REGRADING DESIGN AND ENGINEERING COST ASSESSMENT

An engineering assessment of the cost and efficacy of various slope stabilization methods for the South End waste rock piles has also been completed. Bill Rose of WLR Consulting Inc. based in Lakewood Colorado was contracted to perform the design work. A cost estimate has also been completed based on the reclamation design. All work was performed using Minesight® software and the topographic maps showing the potential contoured surfaces were created in AutoCAD R-2000 from the Minesight® files.

The existing angle of repose slopes for the South End waste rock piles are approximately 1.5:1. The slopes can be reduced by cutting material from the top of the slope and using it as fill material at the bottom of the slope. Cut and fill iterations were performed with final slopes of 2.5:1 and 2.75:1. The preservation of cut off walls was stressed in the reclamation design, since they are the source controls and most effective method of containing acid rock drainage (ARD) from the waste rock. Cut off walls were upgraded or installed in the early to mid 1990's as part of the groundwater remediation activities completed in accordance with the Administrative Order on Consent for the Zone A groundwater plume (USEPA Docket No. CERCLA No. 86-C-0902C), and with the Record of Decision, Kennecott South Zone Site (U.S. Environmental Protection Agency, 2001).

For each iteration, the slopes were designed with 15ft wide benches every 150ft to act as water breaks that will help prevent erosion and formation of gullies on the slope face. The results of the iterations are summarized in Table 1.

Table 1. Regrading Design of the South End Waste Rock Areas

Iteration Number	Slope Angle	Cubic Yards Moved	Tons Moved	Newly Disturbed Acres	Cutoff Walls Covered
1	2.5:1	25,000,000	42,000,000	140	2
2	2.75:1	31,000,000	53,000,000	174	5

Although shallow slopes (2.75:1) allow for safer access for reclamation and seeding equipment, they also require that more material be moved for greater distances, native undisturbed land at the foot of the dump slope be covered with waste rock, and that more cutoff walls be covered with waste rock. The cutoff walls and associated sumps and pipelines are the primary water collection systems at the foot of the South End waste rock piles and prevent ARD contamination of the underlying aquifer.

Due to the NRD/CERCLA obligations for maintaining cutoff walls and groundwater protection, the most feasible slope reduction option, with the least impact on the collection system, includes a slope reduction of 2.5:1. In this option, all the cutoff walls are preserved except for two in the Olsen and Castro South Drainages. Using this plan, approximately 25,000,000 cubic yards of material will need to be moved and 140 acres of native land would be disturbed. The area of the regraded surface is estimated at 481 acres. Inter-basin or drainage transfers will comprise approximately 10 to 13% of the total waste rock handled.

A 1" = 600' scale map (Drawing No. 454-T-0031) showing the topographic contours for the 2.5:1 regraded surface is contained in Attachment B. The top and toe of the existing dump angle of repose slopes are shown as yellow lines on the map. The cutoff wall locations are shown as short red dashes in the drainages beneath the waste rock dumps. Table 2 (Attachment B) contains a cost estimate for regrading, topsoil application and vegetating the South End waste rock piles by drainage. The total cost for reclaiming the South End Waste Rock piles is $43,188,340 with 20% contingency.

Cost estimates are based upon $1.30 per cubic yard for movement (cut and fill) of waste rock, $9680 per acre for soil hauling and placement of an 18" cap, and $500 per acre for drill, seed and cross rip. KUCC is carefully evaluating all impacts related to reducing the slope and reclaiming the South End waste rock piles.

Please contact me at 569-7120 or Vicky Peacey at 569-7118 if you have any questions or comments relating to this study.

Sincerely,

Paula Doughty

Paula Doughty
Director, Environmental Affairs

Attachments:
cc: Dan Hall (DWQ)

ATTACHMENT A

RISK ASSESSMENT OF KENNECOTT UTAH COPPER CORPORATION MINE WASTE ROCK DISPOSAL AREAS

by

Call & Nicholas, Inc.

CALL & NICHOLAS, INC.

2475 N. Coyote Drive
Tucson, Arizona 85745 U.S.A.

Tel: (520) 670-9774
Fax: (520) 670-9251
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Principals
D. E. Nicholas, P.E
P. F. Cicchini, P.E.
T. M. Ryan, P.E.
P. R. Pryor, P.E.

MEMORANDUM

TO: Dr. Zavis Zavodni / Rio Tinto Technical Services

FROM: Richard D. Call, P.E.

DATE: 5 April 2004

SUBJECT: Review of Bingham Waste Dumps

1.0 INTRODUCTION

This report is the result of a risk assessment of the Kennecott Utah Copper (KUC) Bingham mine waste dumps. Three days (19-21 November 2003) were spent visually inspecting the dumps, meeting with Bingham personnel, and reviewing documents provided. Dr. Zavis Zavodni of Rio Tinto Technical Services participated in the review as the internal reviewer. The conclusions of this review are based on information from oral presentations and documents provided. No independent verification of the accuracy and completeness of the information was made.

2.0 RISK ASSESSMENT

The risk assessment presented in Table 1 is based on the likelihood and consequence classifications established by Rio Tinto (Appendix A). The primary risks considered were:

1. Shallow surface slumps and debris flows
2. Deep seated large-scale failures
3. Acid rock drainage

The waste dumps were grouped into the following areas as shown on Figure 1:

1. South dumps
2. East dumps
3. Upper dumps
4. Bingham Canyon dumps

3.0 OBSERVATIONS ON RISKS CONSIDERED

3.1 Shallow Surface Slumps and Debris Flows

The primary causes of slumps and debris flows are sudden heavy precipitation or snowmelt and/or water on the dump surface flowing over the dump crest. Contributing factors are fines concentrated on the dump outslope and degradation of run-of-mine waste rock. In active dumps, slumps can be the result of oversteepening because of too rapid a dumping rate.

The consequences of this type of event can be a debris flow that extends beyond water cutoff and containment structures, resulting in downstream contamination. The attached map shows the location of source controls including cutoff walls, catch basins, collection pipelines, and monitor wells along the length of the Bingham, East and South dumps.

An example of this type of event is the 1997 debris flow of the South dump into the Olsen drainage. An estimated 1100 tons of sediment passed over the containment structures. Some sediment continued to flow downstream in Butterfield creek and a small amount ultimately entered the Herriman irrigation system. This event was triggered by 1.32 inches of rain in a one-hour period.

3.1.1 South Dumps

The South dumps are the most critical for this type of event as the material in the dump face is finer grained and more altered than most of the other KUC dumps, so that slumping is more likely. Also the potential of contamination extending off company property is greater.

The short term remediation possibilities are additional check dams and control of the water on the surface of the dump to minimize saturation of the material in the dump face. For the long term, the reclamation planning team is considering resloping and revegetation.

3.1.2 East Dumps

The East dumps are likely to have small debris flows that are contained above or in the cutoff structures. The consequence of these flows is relatively minor, consisting chiefly of cleaning out the cutoff structures.

The East dumps are older, inactive dumps composed in large part of quartzite, which is less subject to alteration and tends to remain a coarser material. Also, portions of the dumps have been recontoured with reduced slope angles and some areas are vegetated.

Therefore a debris flow extending past the containment structures is unlikely, but the consequences are greater, because there would be contamination below the containment structures. Even so, there is a low probability that the contamination would exit off company property.

3.1.3 Upper Dumps

The upper dumps are older and have some revegetation, so slumping is unlikely. Debris flows would be into the pit area, so the environmental consequences would be minor. It is considered very unlikely that the debris flows would reach any active mining areas.

3.1.4 Bingham Dumps

The Bingham dumps are currently active so slumping due to normal consolidation is likely. However, debris flows extending past the containment structures is unlikely. The more probable consequence would be disruption of select water quality monitoring wells located near the toe of the active finger dump.

Slumping can be minimized by 1) control of the dumping rate, 2) shape of the dump face, and 3) control of the location of unfavorable (low-strength) material.

The current reclamation plan for the Bingham Canyon dumps is to recontour and stair-step the final dump face to a 2.75:1 slope and to cap and revegetate the dump faces.

3.2 Deep Seated Large-Scale Failure

The probability of a deep seated failure of the inactive older KUC dumps is very low, even if the dumps are assumed to have been at limiting equilibrium when constructed. There are three factors that contribute to their current stability:

1. The dumps have consolidated because of settlement over time, which has increased their effective shear strength.
2. The empirical evidence from excavation and drilling of older dumps is that cementing of the dumps has occurred with a significant increase in effective

shear strength. This cementing is from the deposition of iron oxide compounds from the chemical weathering of sulfide-bearing rock.

3. During leaching of the dumps, there was significant localized pore pressure generated by the addition of leach water. With the leaching now stopped, the pore pressure will have decreased so the dumps have a greater effective shear strength and are more stable than they were during leaching.

The consequence of a large-scale KUC dump failure would be significant, because the material and resulting contamination would extend beyond the cutoff structures. The overall risk level is relatively low, however, because of the low probability of occurrence. Nonetheless, controlling the water on the surface of the dumps to minimize water infiltration, thereby reducing the likelihood of generating localized excess pore pressure, should be considered as a mitigation measure.

The dumps should have a displacement monitoring system and periodic geotechnical inspections. Past monitoring of the dumps has shown that significant measurable displacement occurs prior to any major instability. The monitoring system would provide quantitative data to confirm stability or to anticipate major movement.

3.3 Acid Rock Drainage

The evidence presented during the inspection indicates that the Eastside collection system is effective in containing the acid rock drainage (ARD). The cutoff system was constructed to handle 25,000 gpm from dump leaching. With the termination of leaching, the flows have declined to less than 1,000 gpm, so the system has the capacity to handle flows much greater than a 10-year, 24-hour storm event.

Since the consequences of ARD going into the Salt Lake basin are very high, maintenance of the collection system is very important. Capturing runoff from above the dumps, and surface water on the dumps, would reduce the infiltration of water into the dumps and the resultant generation of ARD.

3.4 Bingham Canyon Active Dump

The final configuration of the Bingham Canyon dump as presented in the reclamation plan is a recontoured slope with a maximum angle of 2.75 to 1 to be capped and vegetated. This plan should have an acceptably low risk of failure.

The current plan of building out a finger dump to avoid covering the lower Dry Fork monitoring wells and drilling through the dump to reestablish these monitoring wells is of greater concern, particularly as there are some tight constraints on the time during which the monitoring wells are not functioning. This plan requires rapid dumping with an unfavorable dump geometry, which increases the likelihood of both slumping and deep seated instability. Efforts should be made to alleviate the need to maintain the select monitoring wells at the immediate dump base. This would allow dumping in a more favorable broad dump configuration at a lower rate of advance.

Controls on the rate of face advance, dump face geometry, and location of unfavorable material placement, based on geotechnical evaluations, are required. Also, real-time displacement monitoring (i.e., extensometers) and regular geotechnical inspection should be instituted.

3.5 Angle of Repose East Side Dumps

The current reclamation plan will leave the high angle of repose East dumps as they are. There is a possibility that a new regulation would require resloping and revegetation of these dumps because of the construed negative visual impact. This regulation would have a high consequence because of the quantity of material that would have to be moved for resloping and because of the difficulty of revegetation due to the pyrite content, salinity, and low pH of dump material. Also, resloping would have a negative environmental impact, because disturbing the cemented and stable material would result in increased production of ARD and loose material, which is more subject to erosion.

The likelihood of this consequence is political rather than geotechnical, so the determination of likelihood should be done by someone more familiar with the regulatory environment. Because of this, the consequence of a regulatory requirement was assessed as a "critical comment" in the context of this inspection.

4.0 RECOMMENDATIONS

4.1 South Dump Debris Flow

The highest risk noted during this review is a repeat of the 1997 South dump debris flow. Having a repeat of a previous event would be an unfavorable indication of failure to deal with known risks. The effectiveness of existing containment structures should be evaluated and additional containment structures constructed as needed.

4.2 Surface Water Control

Controlling surface water on the dumps to minimize infiltration and runoff over the crest has a positive effect on both shallow and deep seated instability, and it reduces ARD. The capture of runoff above the dumps should be reevaluated and the top surface of the dumps should be regraded to control water flow.

4.3 Inactive Dump Monitoring

Survey points should be placed on the inactive dumps so displacement can be monitored to confirm stability and to provide early indications of instability. Monitoring should be completed monthly as a part of a routine geotechnical inspection.

4.4 Active Dump Design and Monitoring

The procedures for trucks as described in the document *Dumping at the Dump* are very good. Operator awareness is an important part of the safety program. Truck spotting should be practiced. However, it is inappropriate to leave the monitoring and geometry of dump faces solely to the truck drivers. A geotechnical dump plan/design must be developed for the active Bingham Canyon dump. Geotechnical evaluation of dumping rate, dump geometry, and placement of material should be ongoing; rapidly building a nose with poor material greatly increases the probability of instability.

The active dumping areas should have real-time displacement monitoring (extensometers) and regular geotechnical inspection. If an accident were to occur due to dump instability, there could be an issue of negligence given the past success of predicting dump instability with monitoring.

RDC 12/16/03
Revised 2/25/04
Revised 4/5/04

Table 1. Bingham Waste Dump Hazard Evaluation

No.	Hazard Description	Likelihood Rating	Consequences		Risk Level	Existing Controls	Possible Mitigation Measures
			Description	Rating			
1	**South dumps**						
1a	Shallow surface slumps and debris flows	Likely	Mud flow into Butterfield Creek and Herriman	Moderate	5	Water cutoffs and check dams	Additional check dams Control of surface water to minimize flow over crest Resloping and vegetation
1b	Deep seated large-scale failure	Very unlikely	Slide debris into Butterfield Canyon	Moderate	3		Control of surface water to minimize pore pressure in dumps Monitoring displacement to confirm stability
1c	Acid rock drainage passing cutoffs	Unlikely	Contamination of Butterfield Creek and Herriman water supply	Moderate	4	Water cutoffs and check dams	Control of surface water
2	**East dumps**						
2a	Shallow surface slumps and debris flows retained above cutoff	Likely	Debris in cutoff structures	Very low	3	Minor check dams	Additional check dams Control of water on dump to minimize dump saturation and flow over crest
2b	Shallow surface slumps and debris flows extending beyond cutoff structures	Unlikely	Contamination beyond cutoff	Moderate	4	Minor check dams	Additional check dams Control of water on dump to minimize dump saturation and flow over crest
2c	Deep seated large-scale failure	Very unlikely	Contamination beyond cutoff	Moderate	3	Dump leaching discontinued	Control of water on dump to minimize dump saturation and flow over crest Monitoring displacement to confirm stability
2d	Acid rock drainage passing cutoffs	Unlikely	Contamination requiring major remediation	Moderate	4	Cutoffs and monitoring wells	Control of water on dump to minimize infiltration of surface water
2e	New environmental requirement to reslope and revegetate dumps	???	Major haulage of dump material increased ARD and erosion	High	Crit C.		

Table 1. Bingham Waste Dump Hazard Evaluation

No.	Hazard Description	Likelihood Rating	Consequences		Risk Level	Existing Controls	Possible Mitigation Measures
			Description	Rating			
3	**Upper dumps**						
3a	Shallow surface slumps and debris flows	Unlikely	Accumulation of debris at toe of dump and possible transgression into upper pit	Very low	2	Some revegetation	Control of surface water to minimize flow over crest Revegetation
3b	Deep seated large-scale failure	Very unlikely	Slide material in pit	Low	2		Control of surface water to minimize pore pressure in dump
3c	Acid rock drainage	Likley	Contaminated water flowing into upper pit	Very low	3		Control of surface flow and cutofs above dump
4	**Bingham dump**						
4a	Shallow surface slumps and debris flows	Likley	Accumulation of debris at toe of dump Loss of truck and or dozer	Moderate	5	Operational dumping pratice	Control of dumping rate, dump shape and material distribution Geotechnical monitoring and design
4b	Deep seated large-scale failure	Very unlikely	Slide material extending beyond dump toe Loss of truck and or dozer	Moderate	3	Operational dumping pratice	Control of dumping rate, dump shape and material distribution Geotechnical monitoring and design
4c	Acid rock drainage passing cutoff	Unlikley	Contamination beyond cutoff	Moderate	4	Cutoffs and lower Bingham Canyon remediation	Control of dumping rate, dump shape and material distribution Geotechnical monitoring

APPENDIX A. Risk Assessment Classifications[1]

A-1. Likelihood Classification

	Very Unlikely	Unlikely	Likely	Highly Likely
Frequency of multiple events	>1/10 years	1/year to 1/10 years	1/month to 1/year	>1/month
Probability of single events	<0.1%	0.1% - 1%	1% - 10%	>10%

A-2. Consequence Classifications

Economic Consequence Classifications

	Consequences			
	Very Low	**Low**	**Moderate**	**Severe**
Annualised Opex or Capex or Revenue	< 5%	5% - 10%	10% - 15%	> 15%
Project Delay (critical path)	< 1 month	1 - 3 months	3 - 6 months	> 6 months

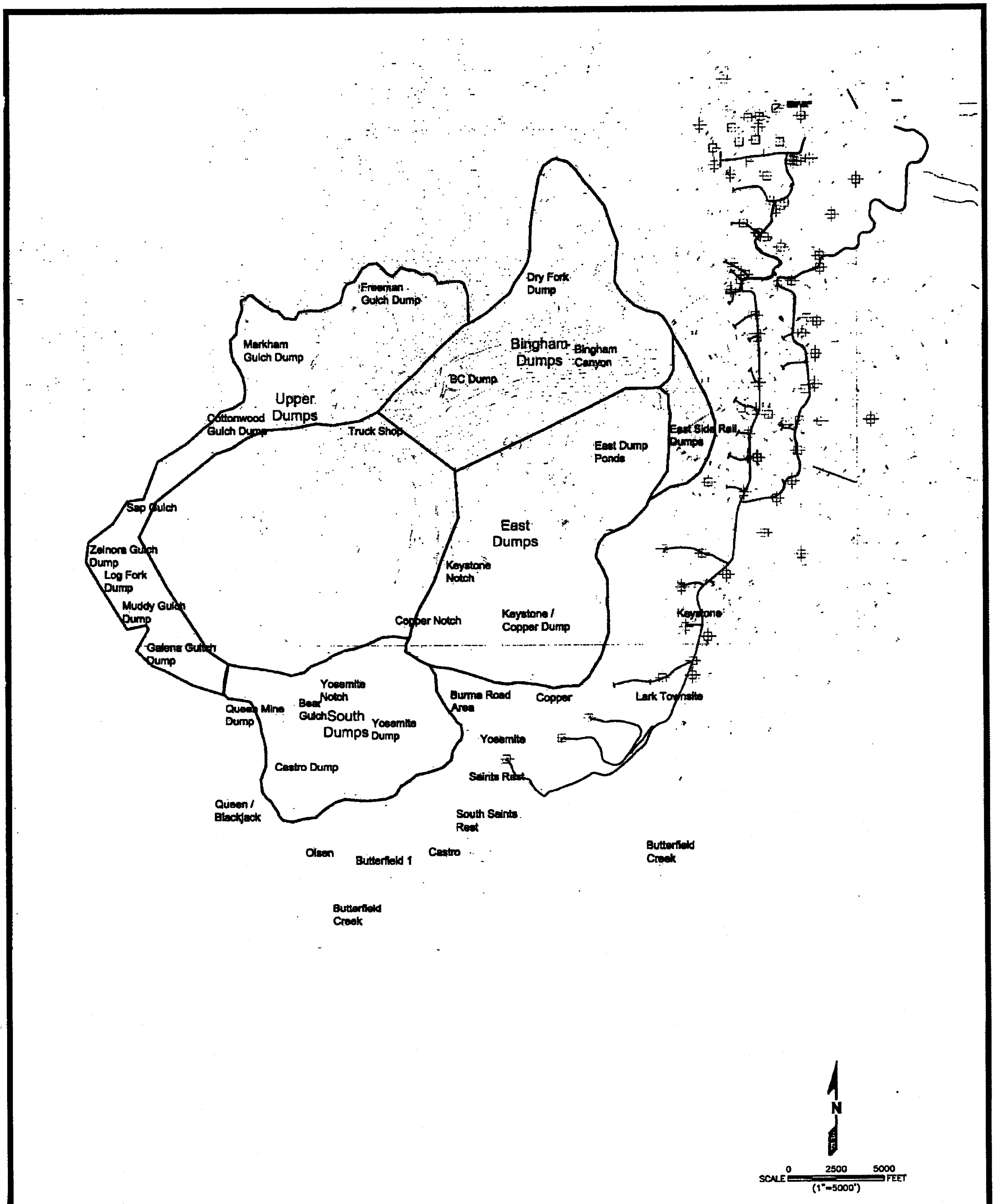
Non-Economic Consequence Classifications

	Consequences			
	Very Low	**Low**	**Moderate**	**High**
Environmental Impact	Localised Degradation	Extended Degradation	Severe Degradation	Catastrophic Degradations
Community Impact	Negligible	Slight	Moderate	Severe
Personnel Safety	No Injuries	Minor Injuries	Serious Injuries	Fatalities
Rio Tinto Reputation	Negligible	Slight	Moderate	Severe

A-3. Risk Determination Matrix

	Most Serious Consequence			
	Very Low	**Low**	**Moderate**	**High**
Very Unlikely	Level 1	Level 2	Level 3	Level 4
Unlikely	Level 2	Level 3	Level 4	Level 5
Likely	Level 3	Level 4	Level 5	Level 6
Highly Likely	Level 4	Level 5	Level 6	Level 7

[1]Vick, Steven G., PE, March 31, 2003, Final tailings facility review, Letter Report to Mr. Felix Blatt, Kennecott Utah Copper, Magna, Utah, USA. Prepared by Steven Vick,PE, Bailey, Colorado, USA



LEGEND

- LEACH WATER COLLECTION SYSTEM
- STORM WATER COLLECTION SYSTEM CANAL
- STORM WATER COLLECTION SYSTEM UNDERGORUND
- CUTOFF WALLS AND COLLECTION PIPES
- COMPLIANCE MONITORING WELLS
- OPERATIONAL MONITORING WELLS
- LEACH AND METEORIC LEACH WATER COLLECTION SITES
- TUNNELS, SURFACE SEEPS, AND REPOSITORY LEACHATE COLLECTION SUMPS
- DRAINAGE PATTERNS

CALL & NICHOLAS, INC.
TUCSON, ARIZONA USA

DRAWN LMC	DATE 4/04	APPROVED
FILE BING\2003\DUMPSTUDY\DUMP_LOC.DWG		

BINGHAM CANYON DUMP LOCATIONS MAP

KENNCOTT / BINGHAM

SCALE	1"=5000'	FIGURE 1

ATTACHMENT B

REGRADING DESIGN OF THE SOUTH END
WASTE ROCK DISPOSAL AREAS

by

WRL Consulting, Inc.

and

RECLAMATION ENGINEERING COST
ESTIMATE OF THE SOUTH END WASTE ROCK
DISPOSAL AREAS

REGRADING			
South End Drainage Basin	**Estimate Volumed (cy x 1000)**	**20% Contingency**	**Regrading Costs**
Yosemite	4,087,000	4,904,400	6,375,720
Saints Rest	7,254,000	8,704,800	11,316,240
South Saints Rest	3,081,000	3,697,200	4,806,360
North Castro	1,514,000	1,816,800	2,361,840
South Castro	2,788,000	3,345,600	4,349,280
Butterfield	1,894,000	2,272,800	2,954,640
Olsen	3,280,000	3,936,000	5,116,800
Queen	648,000	777,600	1,010,880
Total Cost	$24,546,000	$29,455,200	$38,291,760
Regrading unit cost: $1.30			

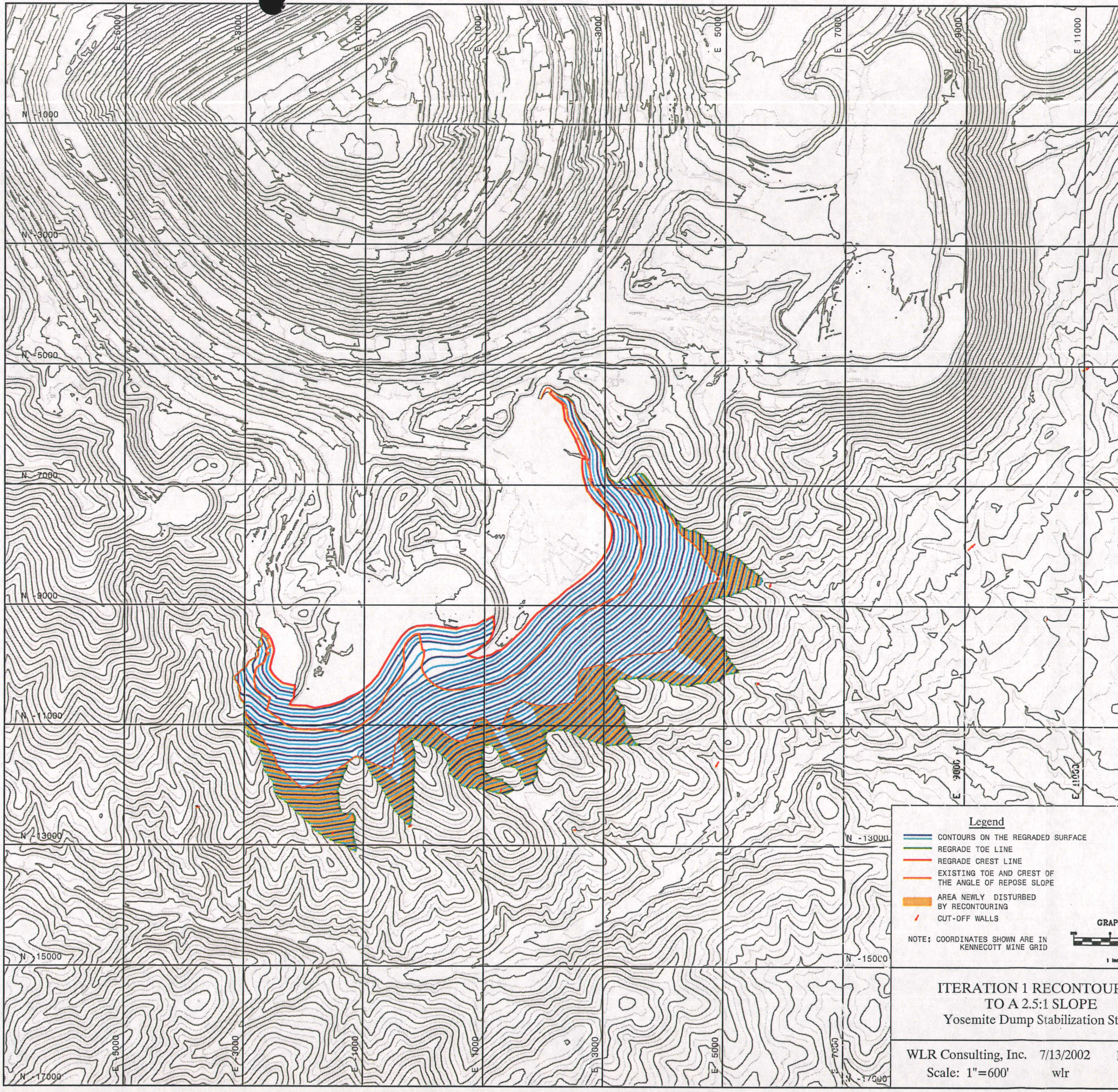
TOP SOIL	
Total Slope Area	481 acres
Topsoil Depth	1.5 ft
Haul	$2.25/cy
Placement	$1.75/cy
Subtotal Unit Cost	$4.00/cy
Total Cost	$4,656,080

REVEGETATION	
Total Slope Area	481 acres
Drill, Seed, Crossrip	$500/acre
Total Cost	240,500

GRAND TOTAL	
Regrading Subtotal	$38,291,760
Topsoil Subtotal	$4,656,080
Revegetation Subtotal	$240,500
TOTAL DUMP RECLAMATION	$43,188,340

Reference: Bill Rose Estimate July 2002

TABLE 2. South End Waste Rock Piles Recontouring and Revegetation



ITERATION 1 RECONTOUR
TO A 2.5:1 SLOPE
Yosemite Dump Stabilization St

WLR Consulting, Inc. 7/13/2002
Scale: 1"=600' wlr

Attachment 4 – Yosemite Drainage Runoff Control System Capacity Calculations

Yosemite Drainage Storm water Facility Design Review

Drainage Areas (acres):

Undisturbed Areas:	126
Dump Slopes:	37.3
Flat Areas on Dump Tops:	171.9

Related Assumption: Dump tops are bermed and do not report directly to drainage. Assume rainwater reporting to flat dump tops primarily infiltrates and is detained until passage of precipitation event.

Design Storm Event

10 year 24 hour event 2.31 inches Reference: NOAA point precipitation frequency estimate for Bingham Canyon

Runoff Coefficients

Undisturbed Areas

Description: Slopes <30% (average 20%), coarse soils, well established vegetation

Runoff coefficient 0.3 dimensionless Reference: Caltrans Storm Water Quality Handbook, SWPPP/WPCP Preparation Manual, Figure 819.2B

Dump Slopes

Description: slope ~35 deg, no vegetation, crusty surface opens with rain, coarse and rough surface

Runoff coefficient 0.69 dimensionless Reference: Caltrans Storm Water Quality Handbook, SWPPP/WPCP Preparation Manual, Figure 819.2A

Weighted Averaged Runoff Coefficient

0.39 dimensionless

Total Precipitation Volume of Design Event

31.4 acre feet

10,243,208 gallons

7,113 flow (gpm) assuming a 24 hour unit hydrograph

2,768 flow (gpm) with runoff coefficient applied

Structure	Capacity acre-feet	Capacity gallons	Capacity gpm	Source
Upper Desilting Basin	2	651,703		Estimate from survey (DWG 450-C-1337)
Yosemite Cutoff Wall	0.05	16,293		UGW350010
14" HDPE Stormwater Pipeline from COW to 31" storm water collection pipeline	8.84	2,880,000	2000	DWG 450-C-1950
Total		3,547,995	**2464**	
COW spillway when storm is >10 year-24 hour		4,320,000	3000	UGW350010
Total		7,867,995	**5,464**	

Groundwater discharge permit application claims:

Runoff from storm water above the 10 year 24 hour event = 24,000gpm

Capacity of the Storm Water Collection System for the southern drainages is 21,000 gpm (3000 per drainage)

Conclusion

Facility design capacity of 5,464 gpm exceeds design event of 2,768 gpm.

Attachment 5 – Excerpts from April 1996 Eastside Collection Monitoring Network Ground Water Discharge Permit Application Relevant to Yosemite Drainage

GROUND WATER DISCHARGE PERMIT APPLICATION

BINGHAM CANYON MINE

EASTSIDE COLLECTION SYSTEM

Submitted by:

Kennecott Utah Copper, Owner and Operator
Robert R. Dimock, President
8315 West 3595 South
P.O. Box 6001
Magna, Utah 84044-6001

SIGNATURE OF CORPORATE OFFICER

W.R. Williams, Director, Technical Services | Date

GROUND WATER DISCHARGE PERMIT APPLICATION

BINGHAM CANYON MINE
EASTSIDE COLLECTION MONITORING NETWORK

YOSEMITE DRAINAGE

TABLE OF CONTENTS

TABLES

DRAWINGS

4.0 YOSEMITE DRAINAGE

This section provides a detailed description of the Yosemite monitoring well network for the Yosemite drainage. To assist review, this section is presented in the required format for a ground water discharge permit application.

4.1 OWNER INFORMATION

4.1.1 Name and address of owner:

Kennecott Utah Copper
8315 West 3595 South
P.O. Box 6001
Magna, Utah 84044-6001

4.1.2 Name and address of operator:

Kennecott Utah Copper
8315 West 3595 South
P.O. Box 6001
Magna, Utah 84044-6001
Attention: Bruce D. Farmer, President

4.2 LEGAL LOCATION

4.2.1 Legal location of facility

Yosemite Drainage, Salt Lake County, Utah.
Sections 31 & 32, T-3-S, R-2-W

4.2.2 General location plan

The general location of the facility is shown in Drawing 451-T-9101.

4.3 FACILITY DESCRIPTION

4.3.1 Name of facility

Yosemite Monitoring Well Network.

4.3.2 Type of facility

Compliance Monitoring Well for Storm Water Collection Facility.

4.3.3 Description of facility

The Yosemite monitoring well network consists of a compliance monitoring well completed in the principal aquifer downgradient from the Yosemite storm water collection facility, and supporting operational monitoring wells completed in bedrock within the storm water collection site. The storm water collection facility is an integrated set of structures designed to collect storm water and small amounts of acidic leach water generated by meteoric leaching of the Bingham Canyon mine waste rock disposal area.

The components of the Yosemite monitoring well network are illustrated in Drawing 451-T-9104, and are described in detail in Section 4.9.

4.3.4 Life of facility

The compliance monitoring well is designed for a minimum life of 30 years, to match the current expected life of the KUC operation. As all the components are made of long-lived materials, a longer life is expected.

4.3.5 Purpose of facility

The purpose of the Yosemite monitoring well network is to monitor ground water in the principal aquifer downgradient from the Yosemite storm water collection facility to assure compliance with appropriate water quality standards in the ground water of the principal aquifer of the SWJV.

4.4 PLAT MAP

4.4.1 Plat map

Drawing 451-T-9001 is a location map which includes the region around the Yosemite permit application site (the Site). The Site and the Study Area (defined as the area within a one mile radius from the discharge point at the Site) are located on Drawing 451-T-9101. The map includes the topography, drainages, water bodies, agriculture, and man-made structures of the region. The Site consists of the Yosemite drainage, which extends from the toe of the waste rock disposal area to Butterfield Creek.

4.4.2 Wells

Drawing 451-T-9103 locates all the wells in the Study Area. Almost all wells in the Study Area are monitoring wells completed in alluvium, volcanic rock, or Paleozoic bedrock. Table 3-3 gives the description of the monitoring wells along the Eastside waste rock disposal area. There are no municipal water wells within the Study Area. Domestic wells are denoted in Table 4-1.

Table 4-1. Domestic wells in the Study Area.

Well ID	Northing	Easting	GS Elev.	Screened Interval Elev.	Total Depth Elev.
K125	-3000	16500	5660	?	?
KUC Unknown	-2098	17110	5525	?	?
W. Nichols	-5510	18400	5660	?	5560

GS = Ground Surface
? = No data
All elevations in feet AMSL (Above Mean Sea Level).
Northing and Easting are for KUC mine grid (Drawing 451-T-9101), in feet.

4.4.3 Water bodies

There are no permanently filled water bodies in the Study Area. The only water bodies in the region are the lined Bingham reservoirs southeast of Copperton, which are used to manage mine-related water. The lined Large Bingham Reservoir is used for temporary storage of snowmelt, storm water, and overflow of mine process water from the Small Bingham Reservoir, and generally does not contain standing water. The Small Bingham Reservoir is used to provide surge capacity for the leach water recirculation system.

4.4.4 Drainages

Yosemite drainage contains a small perennial stream which surfaces at the toe of the waste rock dumps. Flows from this stream have been estimated by Kennecott staff to be 25 gpm. See Section 3.1.5 for a description of surface water of the region.

4.4.5 Structures

There are no significant man-made structures at the Site other than those described in Section 4.7, the access roads associated with the storm water collection facility at the Site, and the Butterfield Canyon road. In the Study Area, the major structures are the waste rock disposal areas of the Bingham Canyon mine and the Eastside leach collection system, which are described in KUC (1992).

4.4.6 Monitoring wells

Table 3-3 presents completion details for monitoring wells within the Study Area. These wells are completed in either the alluvial (principal) aquifer or the uppermost parts of volcanic or Paleozoic bedrock.

4.5 SITE DESCRIPTION

4.5.1 Topography and climate

Site topography and climate are described in Section 3.1. The ground surface of the Site dips eastward at about eight degrees from approximately 6125 ft AMSL at the base of the Bingham Canyon mine waste rock disposal area to about 5500 ft AMSL in Butterfield Creek.

4.5.2 Geology

The general geology of the Site is discussed in Section 3.1.4. Site-specific details are discussed below and are presented in Drawing 451-T-9102.

Stratigraphy

The major rock unit at the Site is the Paleozoic Butterfield Peaks Formation, which consists mainly of interbedded quartzite and limestone. The Butterfield Peaks formation is intruded by silicic sills and dikes of Oligocene age. Tertiary volcanic rocks also overlie Paleozoic basement at the northern end of the Study Area. Plio-Pleistocene alluvial fan deposits cover the eastern edge of the Site and extend eastward into the SWJV. The alluvial fan deposits range from a few feet to more than 100 ft thick. With the exception of deposits in Butterfield Creek, Holocene alluvium is sparse at the Site and is generally less than 10 feet thick. In Butterfield Creek, alluvium has a maximum thickness of about 100 feet. Colluvium, which covers the hillslopes, is also relatively sparse. A generalized hydrostratigraphic log is presented in Table 3-2.

4.5.3 Hydrology

The regional surface water, ground water, and hydrogeochemistry are described in Section 3.1. The local ground water and hydrogeochemistry are discussed below.

Ground Water

Drawing 451-T-9101 displays the location of two cross sections through the Yosemite Site. Drawing 451-T-9105 depicts in cross section the topography, hydrostratigraphic units, existing wells, and water table within the drainage. The ground surface dips eastward from about 5800 ft AMSL at the cutoff wall of the storm water collection system in the Yosemite drainage to 5710 ft AMSL at well EC932 (see drawing 451-T-9104) to about 5500 ft AMSL at the site of proposed compliance monitoring well EC967. The depth to water is approximately 24 ft BGS (Below Ground Surface) at nearby monitoring well P228 and 80 feet BGS at operational monitoring well EC932. Farther east in the alluvial system of the SWJV, the water table deepens to 150-300 ft BGS.

The ground water within the Yosemite drainage flows in a primarily southeasterly direction (Drawing 451-T-9103). The horizontal hydraulic gradient within the drainage is about 0.06.

Hydrogeochemistry

Bedrock Water Quality. Water quality samples collected in 1992 and 1993 in bedrock along the Eastside storm water collection area are presented in Tables 3-6 and 4-2 below. These results are typical of ground water quality in the area; more recent results are presented in KUC (1995c). Table 3-7 presents total concentrations of critical water quality parameters for adjacent bedrock monitoring wells in the region. Table 4-2 gives water quality data on monitoring wells drilled downgradient from the discharge point in the Study Area. Well EC933 is screened in Paleozoic bedrock; wells EC931 and 932 are screened in volcanic rocks. There is no completion data available for monitoring well P228; it is likely completed in Paleozoic bedrock. The standards presented in Table 4-2 are Utah Ground Water Quality Protection standards (UDEQ 1994), and are provided for reference only.

The bedrock monitoring wells in the nearby area show a wide range of TDS, chloride and sulfate values, with most falling within the range established regionally (Table 3-6) except for chloride and TDS, which are generally higher. High chloride is probably due to the position of these wells close to the Oquirrh Mountain front, where there is the potential for a hydrothermal source of chloride-rich water along range-marginal faults (Dames & Moore 1988; Shepard Miller 1995). The higher chloride concentrations result in higher TDS in these wells. With the exception of somewhat higher concentrations of copper and zinc, metal concentrations in general lie within the range given in Table 3-6. Locally operational monitoring wells have been contaminated with leach water from artificial and natural leaching of the waste rock disposal areas. These sources of ground water contamination were previously intercepted by an earlier cut-off wall system and are now intercepted by the new Eastside leach collection system.

Like the regional wells, some of the bedrock monitoring wells in the Yosemite Study Area contain TDS, chloride, and sulfate concentrations which are elevated above regional values; metal concentrations are in the same range as the regional values for all wells. Wells P228 and EC933 show elevated sulfate and low pH, suggesting contamination by natural leach water; this area was affected by local slope failure of the waste disposal area in the middle 1980s, which may have created local pathways for leach water in the ground water system. The high TDS in well EC931 is due to high concentrations of calcium and chloride.

In summary, monitoring well data suggest that ground water in Paleozoic and volcanic bedrock near the Site is a moderate to elevated TDS, near neutral to slightly alkaline, calcium-sodium-bicarbonate-chloride-sulfate water. Bedrock ground water contains essentially no dissolved trace metals except iron and manganese.

Table 4-2. Water quality in bedrock in the Study Area.

Parameter	P228 10/17/91	EC931[1] 3/17/93	EC932[1] 3/16/93	EC933[2] 3/9/93	Standard
Arsenic	0.006	<0.010	<0.010	0.003	0.05
Cadmium	0.019	<0.005	<0.005	<0.001	0.005
Chromium	NA	<0.002	<0.010	0.013	0.1
Copper	0.011	<0.020	<0.020	0.007	1.3
Lead	<0.005	<0.010	<0.010	<0.001	0.015
Selenium	<0.004	0.010	<0.010	0.023	0.05
Sulfate	5710	367	134	1300	NA
TDS	8452	5010[3]	640	2070	NA
pH (units)	6.41	7.02	7.41	4.34	6.5-8.5
Water level elevation (ft AMSL)	5761[4]	5569	5636	5575	**Note: Dissolved values in mg/l except pH; TDS and sulfate are totals.**
Elevation-top of screen (ft AMSL)	NA	5512.40	5566.91	5551.28	
Elevation-bottom of screen (ft AMSL)	NA	5472.80	5527.31	5511.68	

NA = Not Analyzed/Not Applicable.
Standards = Utah Ground Water Quality Protection regulation (UDEQ 1994)
Notes: 1. Completed in volcanic rock.
2. Completed in Paleozoic bedrock.
3. Chloride concentration = 2050 mg/l.
4. Elevation taken on 8/18/90.
Source: KEL 1993. Results are typical of ground water quality; see KUC (1995c) for more recent analyses.

Principal Aquifer Water Quality. The baseline water quality of the principal aquifer in this region is described in Section 3.1.7. Water quality for the principal aquifer near the Site is discussed in Section 4.8.

4.5.4 Soils and agriculture

Soils and agriculture in the Study Area are discussed in Sections 3.1.2 and 3.1.3, respectively.

4.6 DISCHARGE INFORMATION

4.6.1 Type of discharge

Potential discharges to ground water at the Site consist of storm water from snowmelt and rainfall, and leach water derived from the natural leaching of sulfide-bearing waste rock deposited along the southern and eastern edges of the Bingham Canyon mine (Section 3.2). The local quality of the leach water is presented in Table 4-3, which gives the chemical composition of the leach water in April 1993 which discharged at the toe of the waste rock disposal area in Yosemite and Castro gulches in the Southside area, and barren effluent at the central sump of the Precipitation Plant. Note that no artificial leaching is conducted in the Southside area and that carbonate-rich waste rock buffers acid generation during natural leaching of the waste rock in this area.

Table 4-3. Natural meteoric leach water quality in southern drainages.

Parameter/ Location	Southside Naturally Occurring Leach Water		Precipitation Plant Effluent (Barren Leach Water)
	Castro Gulch	Yosemite Gulch	
Arsenic	0.005	0.005	0.048
Barium*	<0.002	<0.002	<0.002
Cadmium	0.28	0.33	0.85
Chromium*	0.02	0.04	1.7
Copper	88	105	35
Lead	0.61	0.47	<0.05
Mercury*	<0.001	<0.001	<0.001
Selenium	0.016	0.005	<0.005
Silver*	<0.01	<0.01	<0.01
Zinc*	70	18	230
pH (units)	4.5	4.1	3.5
Sulfate	10800	13990	64500
Total Dissolved	13230	19680	106000

All values are totals, in mg/l except pH.
*Barium, chromium, mercury, silver, and zinc data from PPG 1992.
Source: PPG 1993.

4.6.2 Source of discharge

The general source of discharge is described in Section 3.2. Specific locations where discharge of acidic meteoric water to the ground water system is possible are the waste rock disposal area and the Yosemite storm water collection facility.

- **Seepage from the waste rock disposal area**. The waste rock disposal area was constructed over native Paleozoic bedrock, with some soil remaining in position during dumping. The naturally created acidic water passes through the waste rock, reacts with the waste rock to liberate metals and sulfate into solution and then flows along the top of the bedrock under the waste rock until it emerges at the toe of the waste rock, where it is collected in the Yosemite storm water collection facility. A small portion of the acidic water which passes through the waste rock may seep into the bedrock ground water system, and this provides the possibility of loss of acidic meteoric water from the storm water collection system. This acidic water will react with the underlying rocks, mainly Paleozoic carbonates, be neutralized, and will be diluted by clean water from the recharge system of the Oquirrh Mountains (see Section 3.2.1).

- **Yosemite storm water collection facility**. Under extreme flood conditions the potential exists for limited discharges from the system to ground water by the following methods (see Section 4.14 for discussion of potential flood events and flood control):

  1. Desilting basin. The acidic meteoric water is collected first in the desilting basin. The basin is constructed on bedrock, and is lined with 12 inches of compacted clay. A very limited amount of seepage is possible through this liner into the bedrock beneath, due to the head of meteoric leach water in the desilting basins.

  2. Flood Overflow. In the event of a flood flow in excess of the 10-year/24-hour design flood, the desilting basin is designed to overflow. In this extremely rare condition (much less probable than 1:10 years), flood water would leave the storm water collection system and would move downhill into natural drainages.

  3. System Leaks. There exists the possibility that the storm collection system may have small leaks.

4.6.3 Description of potential discharge

Discharges which may occur would be mixtures of storm water and relatively dilute acidic meteoric water. The expected mixtures are in the following order, were such discharges to occur:

TYPE OF DISCHARGE	ACIDIC WATER	FRESH WATER
Seepage from the waste rock	2%	98%
Seepage from desilting basin	75%	25%
Seepage from flooding	5%	95%
Leakage from storm water system	10%	90%

These percentages are estimates, based on expected flow genesis. The acidic meteoric water is the component which contaminates any escaping water. The constituents of the meteoric leach water are relatively constant over time; typical values are presented in Table 4-3. As discussed in Section 3.2.1, a dilution of 50:1 by fresh water is assumed for seepage from the waste rock. It is estimated that on average standing water in the desilting basin will consist of 75 percent meteoric leach water.

4.6.4 Range of discharge

During spring melt-off or storm events, the surface flow of naturally occurring acidic water from the toe of the waste rock at the Yosemite drainage has been estimated by Kennecott staff to be no more than 100 gpm. As no future discharges to ground water are expected to occur at significant rates after installation of the new storm water collection system, only estimates of the total rates of discharges to the ground water system can be given. These are computed on a time-weighted average, based on the probabilities of their occurrence. In addition, all rates of discharge are stated in the equivalent rate of discharge of full concentration leach water.

Seepage From the Waste Rock. The seepage from the waste rock to bedrock is controlled by the permeability of the rock material beneath the waste rock, the head gradient in that material, and the area of the waste rock which is tributary to the Yosemite catchment. A very approximate estimate of the flow can be developed from Darcy's law:

$$Q = K\,i\,A$$

where:

Q = flow rate (L^3T^{-1})
K = hydraulic conductivity (LT^{-1})
i = hydraulic gradient (dimensionless)
A = area of flow (L^2)

Vertical flow of acidic water to underlying bedrock. The mean hydraulic conductivity of Paleozoic bedrock in its unaltered state is 4.8×10^{-5} cm/sec (Table 4-4), and the vertical hydraulic gradient in the rock is assumed to be unity (the maximum it can attain) for flow of water that actually enters the rock. The area of the waste rock disposal area which is "tributary" to the Yosemite catchment is about 2000 feet wide and 6000 feet long. Using these values, the maximum vertical seepage of acidic water from the waste rock in this area would be 8500 gpm.

Table 4-4. Hydraulic conductivity of Paleozoic bedrock

Well Number/Location	Interval Tested (feet below ground surface)	Hydraulic Conductivity (cm/sec)	Lithology
EC933 Saints Rest/Yosemite	118.79 - 144.29	5.4×10^{-4}	Quartzite breccia
	149.05 - 174.55	1.1×10^{-4}	Quartzite & quartzite breccia
EC936 Castro	86.67 - 112.17	2.6×10^{-5}	Limestone & latite/porphyry dike
EC937 Butterfield	270.05 - 295.55	5.3×10^{-4}	Limestone
EC939 Olsen/Queen	109.50 - 135.00	2.5×10^{-5}	Quartzite
EC940 Queen	167.54 - 193.04	5.2×10^{-6}	Limestone & quartzite
	197.15 - 222.65	4.6×10^{-6}	Quartzite & andesite dike
	226.25 - 251.75	6.1×10^{-5}	Andesite dike

Geometric mean conductivity	4.8×10^{-5}
Median conductivity	4.4×10^{-5}

Horizontal flow of acidic water through underlying bedrock. Clearly vertical flow would have to move horizontally to the east in the relatively near-surface zone of the bedrock, as the mountain underflow in bedrock is also seeking to flow out of the system at the same location. This pathway has a limited capacity to conduct the water. Assuming the above permeability, taking the original ground surface slope as the hydraulic gradient (12° or a slope of 0.21), taking a width of the area of 2000 feet, and assuming that the depth of penetration of the acidic water from the waste rock into the underlying material is no more than 150 feet (Section 3.2.1, Figure 1), the flow computes to be about 45 gpm.

As discussed in Section 3.2.1 and based on the bedrock and acidic meteoric water quality data (Tables 4-2 and 4-3), the acidic water in bedrock is diluted by at least 50:1. Accordingly, horizontal flow of acidic water from the waste rock disposal area is about 0.9 gpm.

This estimate indicates that the acidic water which is lost from the base of the waste rock disposal area is very small when considered in the context of the size of the body of receiving water into which it would ultimately pass.

Seepage From the Desilting Basin. Seepage from the desilting basin will have to take place through the layer of compacted clay on the floor of the basin, and then through the underlying bedrock. The approximate flow rate from the desilting basin can be evaluated by considering vertical downward flow from the desilting basin to the water table in the bedrock, again using Darcy's law.

The inundated area of the desilting basin is expected to average about 0.02 acres during normal operation. The hydraulic gradient between the desilting basin and the water table is expected to be close to unity. The hydraulic conductivity of the compacted clay is expected to be about 10^{-7} cm/sec to 10^{-6} cm/sec. The thickness of clay is 12 inches, and the average depth of water in the pond is expected to be 3 ft, which produces a head gradient of 3 across the clay. Using these values in the above equation produces a flow through the liner of 0.004 gpm to 0.04 gpm for the above range of hydraulic conductivity. A reasonable estimate of average flow would be 0.01 gpm for the basin, of which 25 percent will be fresh water or 0.0075 gpm of acidic meteoric water.

Seepage of Flood Water. Seepage of flood water due to overtopping of the storm water collection system is expected to be insignificant: the water quality is expected to be relatively good because of the dilution of acidic water by fresh surface water and the time of inundation small (ten days each century).

Seepage from System Leaks. System leaks are not expected, as can be ascertained from the design information provided about the collection system. However they are possible, and an allowance of 0.1 gpm of leakage is made to account for the total storm water system in the Yosemite catchment. It is estimated that 90 percent of this water will be fresh water; therefore the contribution of leach water will be 0.01 gpm.

Summary of Seepage Losses to Ground Water. The seepage losses from the storm water system to ground water, which are the subject of monitoring, are estimated to be as follows:

TYPE OF DISCHARGE	ACIDIC WATER	FRESH WATER	FLOW RATE (gpm)
Seepage from the waste rock	2%	98%	0.9
Seepage from desilting basin	75%	25%	0.008
Seepage from flooding	5%	95%	0
Leakage from storm water system	10%	90%	0.01
Total estimated release of leach water (gpm)			~0.9

4.7 CONTROL OF DISCHARGES

The Yosemite monitoring well network is not designed to control discharge; discharge control is accomplished by the storm water collection facility (Drawing 451-T-9080). Therefore to clarify discharge control, this facility is described below. The monitoring well network is described in Section 4.9.

4.7.1 Control method

Design. The Yosemite storm water collection facility is designed to collect storm water and acidic meteoric water generated by natural leaching of the waste rock disposal area. The components of the Yosemite facility are illustrated in Drawing 451-T-9104, and are as follows:

- **Cutoff wall**. A concrete cutoff wall will be installed at the toe of the future limit of the waste rock disposal area in the drainage. The wall is founded in Paleozoic bedrock and will intercept all storm water and acidic meteoric water which flows on the surface or through the alluvium from the toe of the waste rock disposal area.

- **Desilting basin**. The cutoff wall impounds a small desilting basin, where silt is allowed to settle out of the storm water prior to the storm water being passed to the main storm water collection pipeline. The capacity of the desilting basin is 0.05 acre-feet.

- **Spillway**. The desilting basin has a spillway designed to pass flood water flow in excess of 3000 gpm when flow to the basin exceeds the 10-year/24-hour runoff or storm event.

- **Pipeline**. The cutoff wall is fitted with an inlet structure, which conducts water to a pipeline. The storm water then flows under gravity down the pipeline to the east, a distance of about 1500 ft. The pipeline is made of HDPE, in order to provide the maximum resistance to corrosion and erosion. It is buried three feet below the surface to protect the pipe from vandalism and freezing.

- **Tributary connection box**. A tributary connection box is constructed at the junction of the Yosemite pipeline and the main storm water collection pipeline. This system passes the flow from Yosemite drainage into the storm water collection pipeline.

- **Storm water collection pipeline**. The final element of the facility is the storm water collection pipeline. The pipeline conducts storm water from the Yosemite facility area and from areas south of the Yosemite facility to the Large Bingham Reservoir (Drawing 451-T-9001). The pipeline is an HDPE, gravity flow system.

Purpose. The purpose of the facility is to collect meteoric leach and storm water which emerges from the waste rock disposal areas, and to minimize losses of acidic meteoric water from the waste rock disposal areas to surface water and ground water in the alluvial basin to the east of the facility. The facility is designed to achieve this by the following means (see blue-shaded areas on Drawing 451-T-9104 for location of drainage):

1. The cutoff wall intercepts all surface water flowing from the toe of the waste rock disposal areas into the Yosemite drainage and directs it to a lined collection system.

2. The storm water and leach water intercepted by the toe drains/cutoff walls is conducted to the storm water collection pipeline by an HDPE pipeline.

3. Snowmelt and storm water from the waste rock disposal area above the cutoff wall are collected along with the surface collection of leach water. Meteoric water from below the cutoff is collected by the natural drainage and flows east in the natural drainage to Butterfield Creek. Captured storm water is conducted to the Large Bingham Reservoir by the storm water pipeline, at the eastern edge of the storm water collection facility.

4.7.2 Effectiveness of control

Surface Water Effects. Surface water flow is directly controlled by the Yosemite storm water collection facility. Except in the case of system failure or when surface flow exceeds the capacity of the facility, such as potentially the 10-year/24-hour flood event, the facility collects or controls all surface flow above the cutoff wall. Storm water and diluted leach water are conducted to the storm water pipeline. Uncontaminated storm water is conducted via natural drainage to Butterfield Creek. The potential effects of accidental or storm-related discharge to surface water are discussed in Section 4.6.

Ground Water Effects. All potentially contaminated surface water discharges to ground water at the Site are effectively cut off by the Yosemite facility. The only potential surface pathways of contaminated water to ground water that are not affected by the cutoff system are failure of the cutoff system, flood events that exceed the capacity of the system to handle surface water flow, such as potentially the 10-year/24-hour flood event, or drainage of acidic meteoric water to ground water beneath the waste rock disposal area. These pathways are discussed below.

Failure of the Cutoff System

Section 4.6 discusses the potential effect of system failure on ground water. The relatively low hydraulic conductivity of the foundation rock at the Site (Paleozoic bedrock) limits the amount of acidic water that could escape to affect local ground water.

Storm Water Events

If the flow capacity of the system is exceeded, diluted acidic water may infiltrate into the principal aquifer downgradient of the Site. The impact of this type of event is estimated in Section 4.6.

Pathways to Ground Water Beneath the Waste Rock

As discussed in Sections 3.2 and 4.6, this flow is expected to be about 0.9 gpm. Since an operational monitoring well in Paleozoic bedrock is proposed downgradient from the discharge point to the edge of the Study Area (Drawing 451-T-9103), it is anticipated that any bedrock flow to the principal aquifer will be detected and if necessary diverted to the storm water collection system before it reaches the principal aquifer. However, escape of acidic meteoric water through deep flow paths in Paleozoic bedrock is not considered to be a significant problem at the Site, since the Paleozoic bedrock has been found to be chemically active in the Southside waste rock disposal area. In particular, much of it has a high neutralizing capacity. Neutralization will eliminate metals from the acidic water seepage and control sulfate to levels around 2000 mg/l. Thus seepage from/through this unit is expected to carry little chemical mass.

4.7.3 Compatibility with discharge

Section 3.5 discusses the general water quality and applicable water quality standards of the principal aquifer for the Study Area. Table 4-5 presents the ground water standards that are potentially relevant and applicable for the Site. Table 4-5 uses the water quality of an alluvial well near the mouth of Butterfield Canyon, P214A, as sampled in July 1991 (see Table 4-6 below), for the background water quality of the principal aquifer at the point of compliance.

Table 4-5. Compliance water quality standards for Site.

Parameter	Water Quality Standard (UDEQ 1994)	Typical Background	Class II Ground Water Protection Levels (UDEQ 1994)
Arsenic	0.05	<0.004	.013
Cadmium	0.005	<0.005	.005
Chromium	0.1	<0.010	.03
Copper	1.3	<0.010	.33
Lead	0.015	<0.005	.006
Selenium	0.05	<0.004	.013
Sulfate	N/A	190	N/A
TDS	N/A	1500*	1875
pH (units)	6.5 - 8.5	8.1	6.5-8.5

All units in mg/l except pH.
N/A = Not Applicable.
* = Chloride concentration is ~550 mg/l in this area.

4.8 UNCLASSIFIED GROUND WATER AREA CONSIDERATIONS

4.8.1 Quality of receiving ground water

As discussed in Section 3.5, the ground water of the southwestern edge of the Jordan Valley is not classified but is likely Class II.

The baseline water quality of the principal aquifer is presented in Section 3.1. In addition, three wells which are monitored for ground water quality near the Site, P214A, W22, and W41A provide additional data on the water quality of the receiving ground water (Table 4-6). None of these wells is an adequate groundwater monitoring well under current monitoring well standards: P214A has a broken casing; completion data for W22 is incomplete, the screened interval is uncertain, and water levels cannot be measured; and W41A has multiple screens, is not sampled on a regular basis, and cannot be sampled for water level. The standards presented in Table 4-6 are Utah Ground Water Quality Protection standards; they are provided for reference only.

Table 4-6. Water quality of nearby wells in principal aquifer.

Parameter	**W22,** 1/23/90	**W41A,** 11/6/86	**P214A,** 7/2/91	**Standard**
Arsenic	0.010	<0.004	<0.004	0.05
Cadmium	<0.005	0.007	<0.005	0.005
Chromium	<0.010	<0.010	<0.010	0.1
Copper	0.030	<0.010	<0.010	1.3
Lead	<0.005	<0.010	<0.005	0.015
Selenium	0.007	<0.004	<0.004	0.05
Sulfate	360	1100	188	NA
TDS	1049	2286	1506*	NA
pH (units)	7.00	6.90	8.10	6.5-8.5
Water level elevation (ft AMSL)	~5275?	~5405?	~5427	**Note: Dissolved values in mg/l except pH; TDS and sulfate are totals.**
Elevation-top of screen (ft AMSL)	~5240?	~5375	~5198	
Elevation-bottom of screen (ft AMSL)	~5234?	~5347	~5185	

Standards = Utah Ground Water Quality Protection regulation (UDEQ 1994) NA = Not Applicable
* = Chloride concentration is 546 mg/l.
Source: KEL 1993. Results are typical of ground water quality; see KUC (1995c) for more recent analyses.

These data, as well as the baseline water quality discussed in Section 3.5 indicate TDS from 1,000 - 2,300 mg/l and no exceedances of current Utah water quality standards. Elevated TDS in these wells is largely due to chloride that is well above the regional baseline. Cadmium concentrations in some background wells exceed the proposed Utah standard; this is probably due to cadmium in alluvial sediments and the highly mineralized rocks of the Oquirrh Mountains, as discussed in Section 3.1.7.

4.9 MONITORING PLAN

4.9.1 Monitoring objectives

The ground water monitoring plan for the Yosemite drainage is designed to accomplish the following:

- Establish baseline ground water quality and hydrogeologic conditions in the Yosemite drainage;
- Identify whether mining operations have affected the ground water quality;
- Enable detection of significant ground water quality effects should they occur in the future; and
- Determine ground water quality at the compliance monitoring point.

4.9.2 Monitoring plan

The monitoring program for Yosemite drainage will follow the applicable guidance documents presented in the KUC Groundwater Characterization and Monitoring Plan (KUC 1995a) and KUC's standard operating procedures (SOPs) for water sampling (KUC 1995b). The ground water monitoring plan details sampling methods and analyses, new well construction, the field sampling plan, and the quality assurance project plan. The SOPs present the specific protocols required for ground water and surface water sampling by KUC staff and contractors. The statistical analysis of the ground water monitoring data will be conducted in accordance with the most current version of EPA guidance (c.f., USEPA 1989).

The monitoring plan for Yosemite drainage may include a network of two wells: the proposed compliance monitoring well for the Yosemite drainage (EC967) and the operational monitoring well EC932, as appropriate. The proposed compliance monitoring well for the Yosemite drainage will be sited at approximately 2,000 feet S, 17,000 feet E on the KUC mine coordinate system (Drawing 451-T-9103). These monitoring wells are located downgradient from the potential ground water discharge point as shown on Drawing 451-T-9103. The nearest well (EC932) is approximately 1700 ft downgradient from the storm water cutoff wall in the Yosemite drainage. The compliance monitoring well is about one mile downgradient from the potential discharge site (or cutoff wall) in or near the Yosemite drainage. All monitoring wells will be sampled on an annual basis.

4.9.3 Monitoring well design

The design and installation of new monitoring wells has followed and will follow KUC guidelines for ground water monitoring procedures (KUC 1995a). Each new operational monitoring well is constructed using 2½-inch Schedule 80 PVC. In general, the new operational monitoring wells are drilled to the top of the first water-bearing zone and completed in the upper 40 ft of the water-bearing unit. As noted in Section 3.4, the new compliance monitoring well may be screened in the upper 100 ft of the principal aquifer.

Table 4-7 presents well completion and location information for the monitoring wells in the Yosemite drainage.

Table 4-7. Site monitoring well completion information

Well ID	Northing	Easting	GS Elev.	MPt Elev.	Screened Interval Elev.	Total Depth Elev.
EC932	(-)2325	14914	5713	5714	5567-5527	5527
EC967	**~(-)2000**	**~17000**	**~5500**	**~5500**		

Proposed Compliance Monitoring Well shown in bold.
GS = Ground Surface
Mpt = Measuring Point
All elevations in feet AMSL.
Northing and Easting are for KUC mine grid (Drawing 451-T-9101), in feet.

4.9.4 Ground water sampling

Annual ground water sampling will be conducted following the protocol established in KUC (1995a,b). The ground water analyses may include the following parameters (compliance parameters underlined):

Field/Lab: temperature, <u>pH</u>, conductivity, <u>TDS</u>
Major Cations: aluminum, calcium, iron, magnesium, potassium, sodium
Major Anions: bicarbonate, carbonate, chloride, fluoride, <u>sulfate</u>
Metals: <u>arsenic</u>, cadmium, chromium, <u>copper</u>, <u>lead</u>, selenium.

4.9.5 Areal extent of monitoring

The area which is monitored is shown on Drawings 451-T-9103 and -9104 and cross-section B-B', Drawing 451-T-9105.

4.9.6 Vadose monitoring

As described in Section 4.7, the cutoff wall of the Yosemite storm water collection facility intersects all likely contact of acidic meteoric water with the vadose zone at the Site. In addition the calculations in Section 4.6.4 indicate that the effect of leach water on the subsurface is minor and is confined to the saturated system. Therefore no vadose monitoring is planned.

4.9.7 Closure/post-closure monitoring

There are no present or near-term plans to close the KUC operation. The mining operations have a projected life of more than 30 years. After ground water discharge permits are in place and adequate baseline information has been collected, KUC will work with the appropriate regulatory agencies on the design of a closure/post-closure monitoring program at closure time.

4.10 PLANS AND SPECIFICATIONS

4.10.1 Construction

The construction design for the typical monitoring well is presented in Figure 2 and KUC (1995a). The basic construction components for the storm water collection facility at the Site are described in Section 4.7. Additional drawings for the operational components are available for review at KUC Engineering Services Group.

4.10.2 Modifications

No modifications of the monitoring well network are anticipated. If a failure occurs, the monitoring well design may be modified to respond to the reason for the failure.

4.10.3 Operation

The operation of the facility is described in Section 4.7. The facility life is at least 30 years.

4.11 RECEIVING GROUND WATER

4.11.1 Quality of receiving ground water

The discussion presented both above (Sections 3.3, 3.5, 4.5, 4.8) and in the Groundwater Assessment Report (KUC 1992) gives evidence of a variable ground water quality within the hydrologic system in both the bedrock of the Oquirrh Mountains and the alluvial aquifer of the SWJV. The expected quality of the ground water below the storm water drainage ("receiving ground water") would be best approximated by the water quality cited in Table 4-6.

4.11.2 Description of receiving aquifer

A description of the receiving aquifer is given in Sections 3.1, 4.5 and 4.8 above.

4.12 NEAREST WELL

4.12.1 Distance to nearest well

The downgradient well nearest the boundary of the Study Area is W41A. This well is located approximately one mile below the storm water cutoff wall (Drawing 451-T-2085).

4.12.2 Use of nearest well

The use of W41A is not known but is assumed to be for domestic, livestock, and irrigation use; it has a permitted use rate of 6.7 gpm. W41A has multiple screens, is not sampled on a regular basis, and cannot be sampled for water level. There are three domestic wells within a one mile radius of the Site (Table 4-1).

4.12.3 Water quality in nearest well

Water quality information for W41A is listed in Table 4-6.

4.12.4 Listing/status of wells within one-mile radius

Tables 3-3 and 4-1 give a complete characterization of all wells within a one-mile radius of the Site.

4.13 COMPLIANCE SAMPLING PLAN

4.13.1 Water quality sampling

The compliance monitoring well and nearby operational monitoring wells will be sampled annually for field parameters and water quality using sampling protocols delineated in the KUC SOPs for water sampling (KUC 1995b). Sample parameters will be the same as those described for ground water in Section 4.9.4 and KUC (1995a). Leach water from the waste rock disposal areas will be sampled at least annually at the Yosemite cutoff wall to establish baseline water quality of the potential discharge to ground water. Determination of compliance is discussed in Sections 3.5 and 4.9.2.

4.13.2 Flow monitoring

Since there are no production wells included in the monitoring network, ground water flow to the monitoring wells will not be measured. Flow of leach water in the storm water collection system will be monitored using sampling protocols delineated in the KUC SOPs for water sampling.

4.13.3 Sampling nearby wells

The monitoring plan is described in Sections 4.9.2 and 4.9.5. All monitoring activities will follow procedures set forth in the KUC ground water monitoring plan (KUC 1995a) and SOPs (KUC 1995b).

4.13.4 Sampling parameters

Sampling parameters are described in Section 4.9.4 and are discussed in detail in KUC (1995a).

4.14 FLOODING

4.14.1 Flooding potential

The storm water collection system at the Site is designed to handle the 10-year/24-hour flood event. Storm water which drains from the Yosemite drainage flows to the storm water collection system, where it is carried to the desilting basin of the Large Bingham Reservoir (Drawing 451-T-9101). This water is kept separate from the leach water collection system and is used as make-up water in mining operations.

4.14.2 Flood protection measures

Flood control is accomplished using the storm water collection system, which is described in Sections 4.6 abd 4.7 (see Drawing 451-T-9080) and which is separate from the leach water collection system. As noted above, the storm water collection system for the east side of the waste rock disposal areas of the Bingham Canyon mine is designed to handle in excess of the 10-year/24-hour flood event.

4.15 CONTINGENCY PLAN

No contingency plan is proposed for the following reasons:

- The design of the storm water collection system applies best available technology (BAT) to the prevention of release of contaminants to ground water.
- The monitoring proposal is comprehensive and thorough (Sections 4.9, 4.13).
- The scenarios considered in this application that may produce potential discharges to ground water yield very limited risk (Section 4.6.4).
- There are a potentially large variety of other improbable failure scenarios that could occur but which are presently difficult to anticipate or quantify.

In the remote eventuality of an exceedance of permitted allowable limits, KUC will formulate a mutually satisfactory contingency plan to remediate any discharge of contaminants to ground water in the principal aquifer if such an exceedance occurs.

4.16 INSPECTION

4.16.1 Methods and procedures

The monitoring well network will be inspected when sampled using protocols delineated in the SOPs for the KUC ground water monitoring program (KUC 1995b).

4.16.2 Failure detection

The main criteria for potential failure of a monitoring well are as follows (see KUC 1992b for additional discussion):

- Total depth of well changes.
- Turbidity of well increases.
- Damage to well structure affects the integrity of the well or its seal.
- Well security is breached resulting in irreversible damage.
- Well is blocked.
- Well is dry (this is not necessarily a failure of the well).

As noted above, the wells will be inspected when sampled for potential failure. If a well failure is detected, the well will be replaced or reinstalled.

4.17 EXISTING FACILITY CORRECTIVE ACTION PLAN

4.17.1 Identification of violation

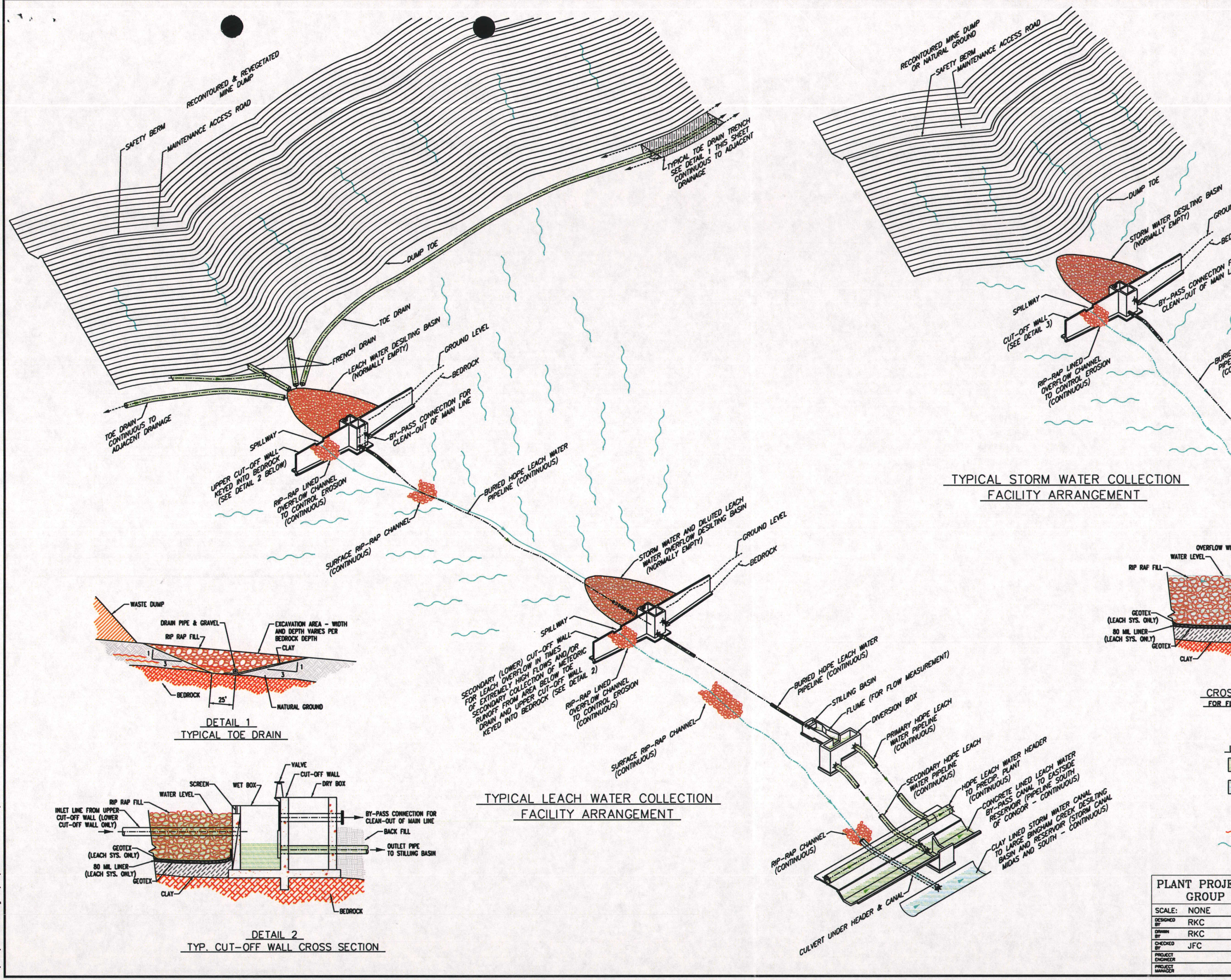
There have been no known violations of existing ground water quality standards in the principal aquifer at this Site.

Prior to the construction of the Yosemite cutoff facility described in this application, the only existing structures on the Site were:

- The waste rock disposal area.
- The unlined storm water collection canal.
- An old cut-off wall.

4.17.2 Response measures

As there have been no violations of ground water quality standards at the Site from previous facilities, no response measures are required. The present application addresses the proposed response to any potential future violations of ground water quality standards.



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DESIGNED BY	RKC
DRAWN BY	RKC
CHECKED BY	JFC
PROJECT ENGINEER	
PROJECT MANAGER	

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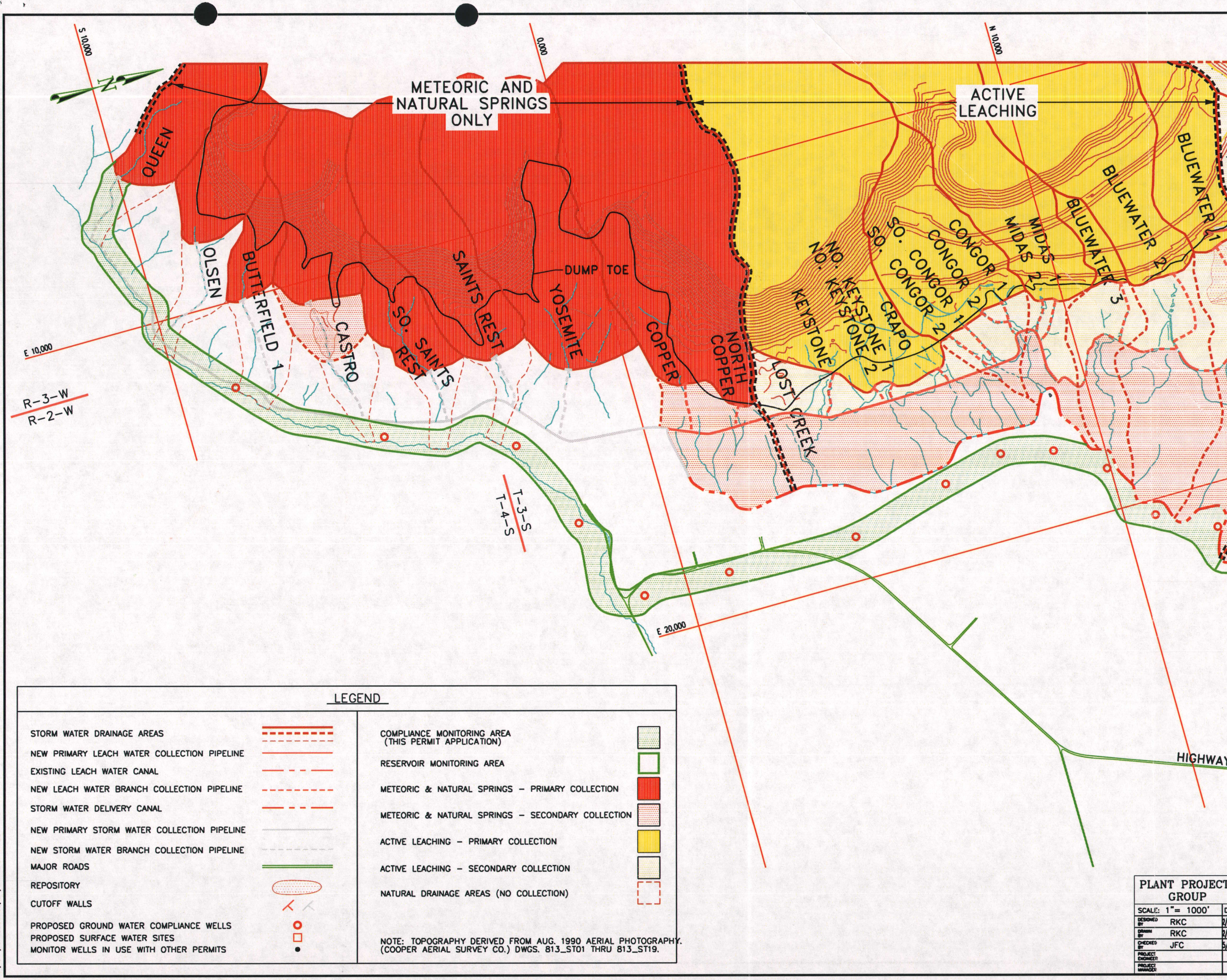

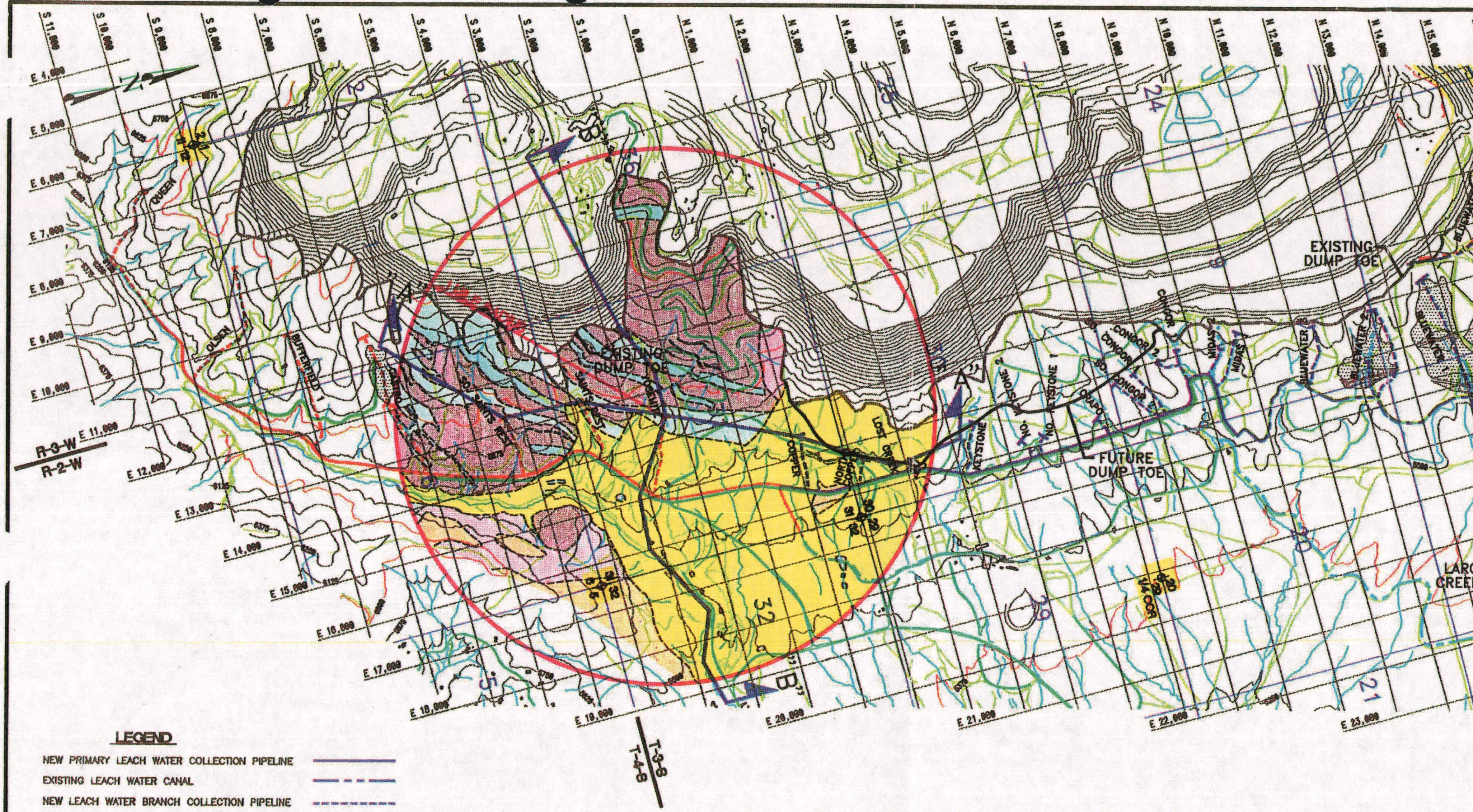

LEGEND

NEW PRIMARY LEACH WATER COLLECTION PIPELINE	
EXISTING LEACH WATER CANAL	
NEW LEACH WATER BRANCH COLLECTION PIPELINE	
EXISTING STORM WATER DELIVERY CANAL	
PRIMARY STORM WATER COLLECTION CANAL (CURRENTLY LEACH WATER COLLECTION CANAL)	
NEW PRIMARY STORM WATER COLLECTION PIPELINE	
NEW STORM WATER BRANCH COLLECTION PIPELINE	
EXISTING TOE OF DUMP	
NEW ACCESS ROAD	
HYDROGEOLOGIC CROSS SECTION LINE	"X" "X"
REPOSITORY	
CUTOFF WALLS	
SECTION CORNER	
SECTION 1/4 CORNER	

NOTE: TOPOGRAPHY DERIVED FROM AUG. 1990 AERIAL PHOTOGRAPHY. (COOPER AERIAL SURVEY CO.) DWGS. 8__ST01 THRU 8__ST19.

GEOLOGY LEGEND

- QUATERNARY ALLUVIUM & TERTIARY ALLUVIAL FAN DEPOSITS
- OLIGOCENE LATITE PORPHYRY NEAR LARK
- OLIGOCENE INTRUSIVE ROCKS – MAINLY SILICIC DIKES & SILLS
- OLIGOCENE LATITE BRECCIA WITH INTERBEDDED TUFF, SANDS & GRAVEL
- OLIGOCENE LATITE BRECCIA
- OLIGOCENE LATITE & ANDESITE FLOWS
- MIDDLE PENNSYLVANIAN BUTTERFIELD PEAKS FORMATION, MAINLY QUARTZITE & SANDSTONE (BROWN) WITH INTERBEDDED LIMESTONE (BLUE)

PLANT PROJECTS GROUP		
SCALE: 1" = 1000'		DATE
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	RKC	8/21/93
	JFC	1/2/93

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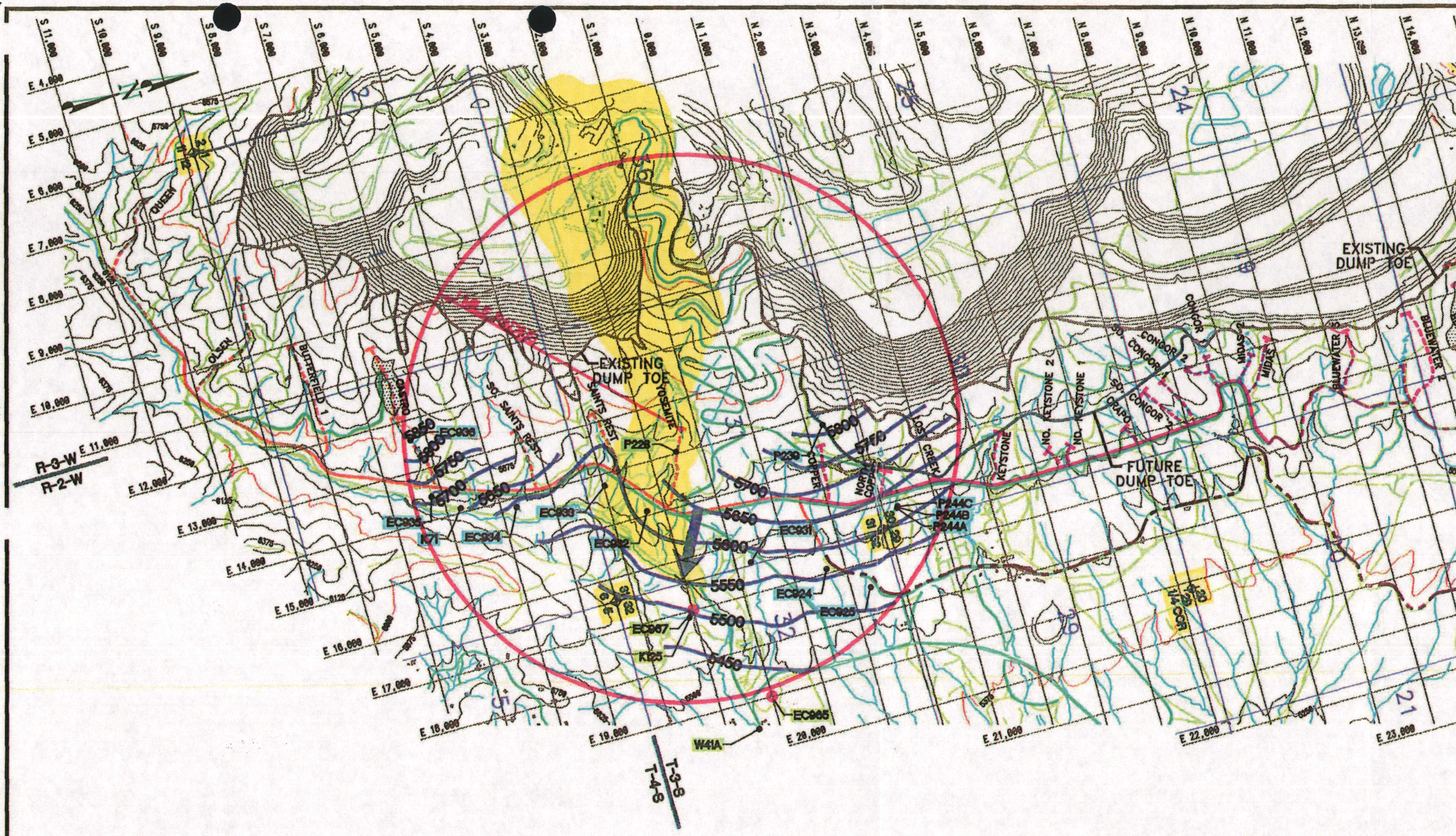

LEGEND

NEW PRIMARY LEACH WATER COLLECTION PIPELINE	
EXISTING LEACH WATER CANAL	
NEW LEACH WATER BRANCH COLLECTION PIPELINE	
EXISTING STORM WATER DELIVERY CANAL	
NEW PRIMARY STORM WATER COLLECTION PIPELINE	
NEW STORM WATER BRANCH COLLECTION PIPELINE	
EXISTING TOE OF DUMP	
NEW ACCESS ROAD	
POTENTIOMETRIC CONTOUR	0000
REPOSITORY	
CUTOFF WALLS	
SITE DRAINAGE AREA SEE DWG. 451-T-9104 FOR DETAILS	
PROPOSED GROUND WATER COMPLIANCE WELL	EC000
EXISTING OPERATIONAL MONITORING WELLS	EC000
SECTION CORNER	
SECTION 1/4 CORNER	

NOTE: TOPOGRAPHY DERIVED FROM AUG. 1990 AERIAL PHOTOGRAPHY. (COOPER AERIAL SURVEY CO.) DWGS. 813_ST01 THRU 813_ST19.

NOTES:

1 - REFER TO DWG.#451-T-9101 OR #451-T-9102 FOR HYDROGEOLOGIC SECTION REFERENCES.

PLANT PROJE GROUP

SCALE: 1" = 1000'

RKC

RKC

JFC

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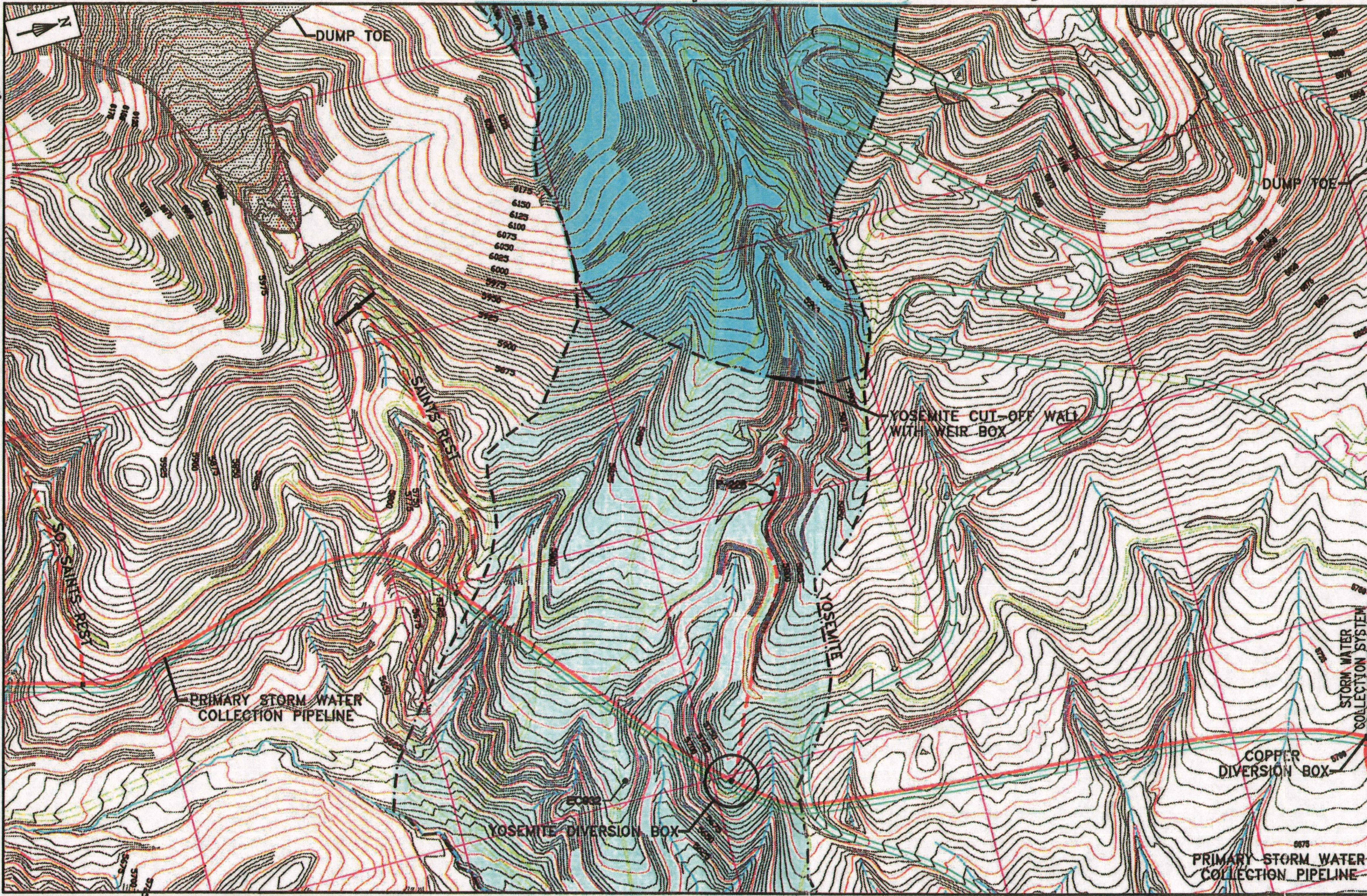

LEGEND

- NEW PRIMARY LEACH WATER COLLECTION PIPELINE
- NEW LEACH WATER BRANCH COLLECTION PIPELINE
- NEW STORM WATER COLLECTION PIPELINE
- NEW STORM WATER BRANCH COLLECTION PIPELINE
- CUTOFF WALLS
- SECTION CORNER
- STORM WATER DRAINAGE
- NATURAL DRAINAGE
- WASTE ROCK DUMPS
- EXISTING TOE OF DUMP
- OPERATIONAL MONITORING WELL

NOTE: TOPOGRAPHY DERIVED FROM AUG. 1990 AERIAL PHOTOGRAPHY. (COOPER AERIAL SURVEY CO.)

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RKC

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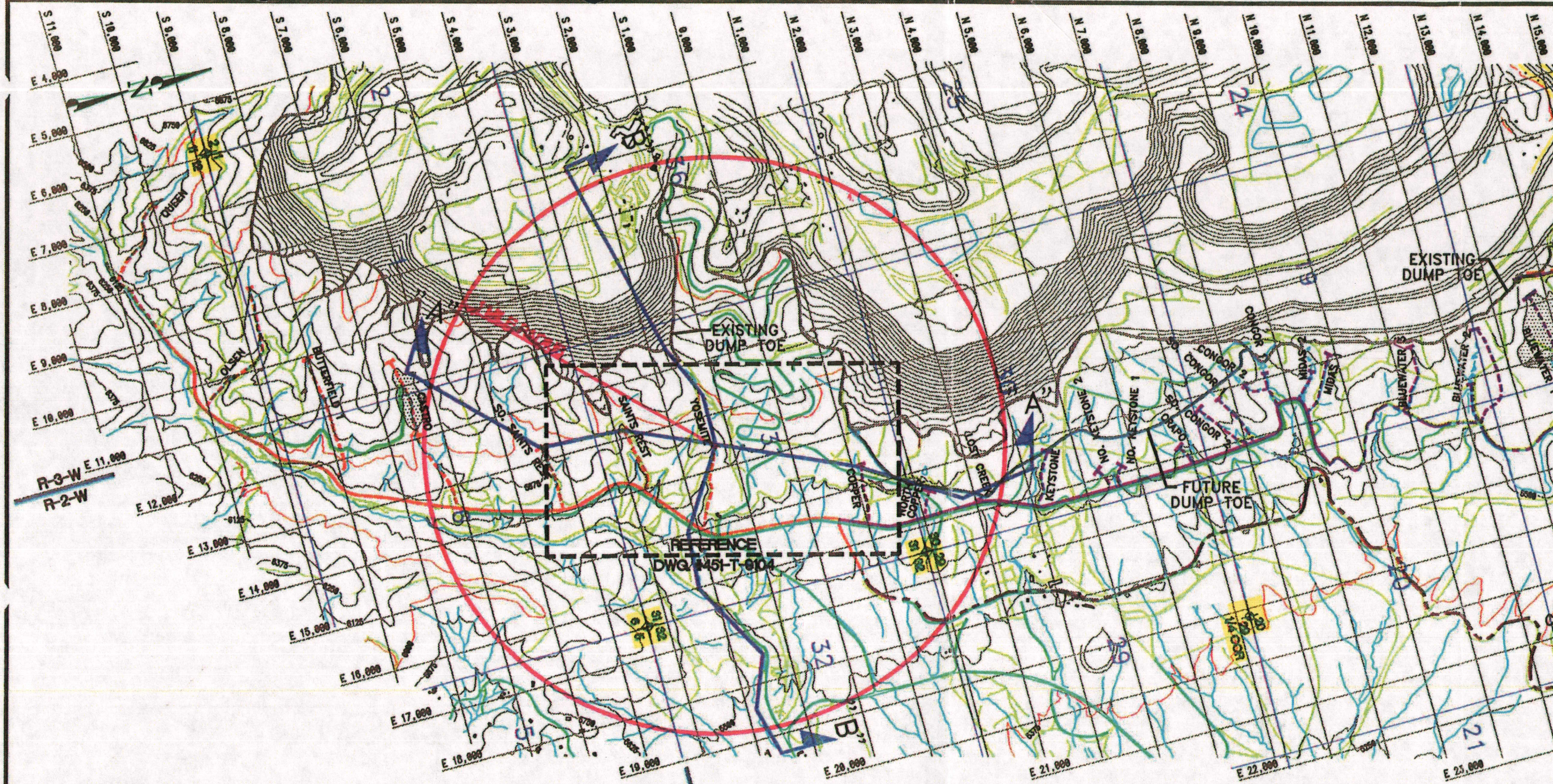
JFC



LEGEND

NEW PRIMARY LEACH WATER COLLECTION PIPELINE	
EXISTING LEACH WATER CANAL	
NEW LEACH WATER BRANCH COLLECTION PIPELINE	
EXISTING STORM WATER DELIVERY CANAL	
NEW PRIMARY STORM WATER COLLECTION PIPELINE	
NEW STORM WATER BRANCH COLLECTION PIPELINE	
EXISTING TOE OF DUMP	
NEW ACCESS ROAD	
HYDROGEOLOGIC CROSS SECTION LINE	"X" "X"
REPOSITORY	
CUTOFF WALLS	
SECTION CORNER	
SECTION 1/4 CORNER	

NOTE: TOPOGRAPHY DERIVED FROM AUG. 1980 AERIAL PHOTOGRAPHY. (COOPER AERIAL SURVEY CO.) DWGS. 013_ST01 THRU 013_ST18.

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REFERENCE DRAWINGS

451-T-9102 SITE GEOLOGY
451-T-9103 SITE HYDROLOGY & WELLS
451-T-9104 DRAINAGE DETAILS – PLAN
451-T-9105 HYDROGEOLOGIC CROSS SECTIONS

PLANT PROJECTS GROUP

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RKC	[illegible]
JFC	11/2/[illegible]

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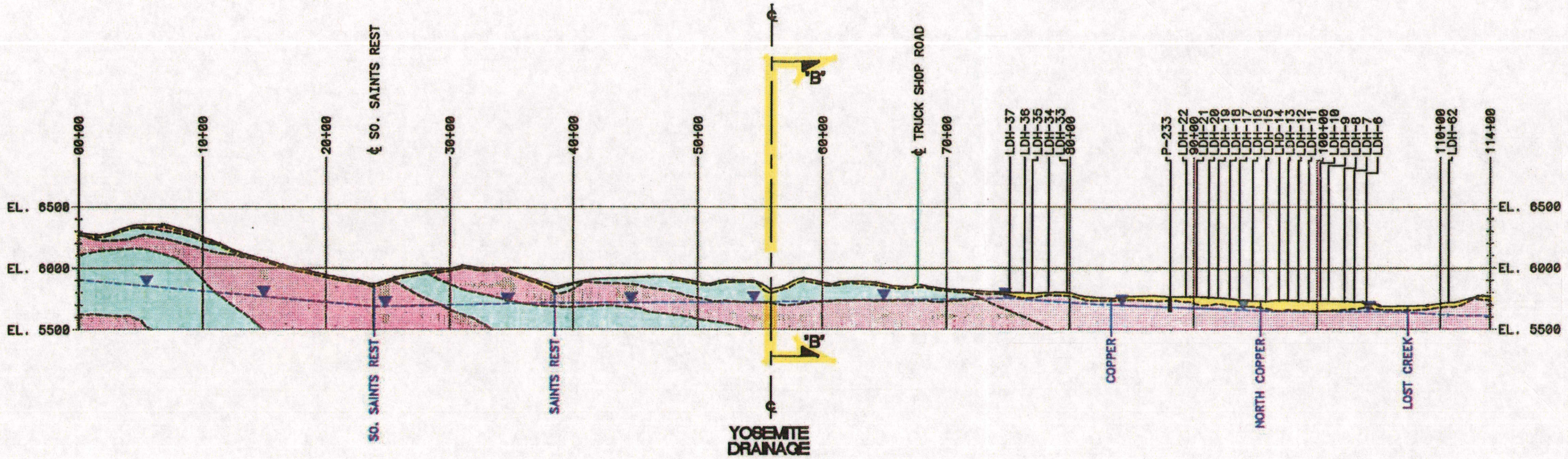

YOSEMITE DRAINAGE
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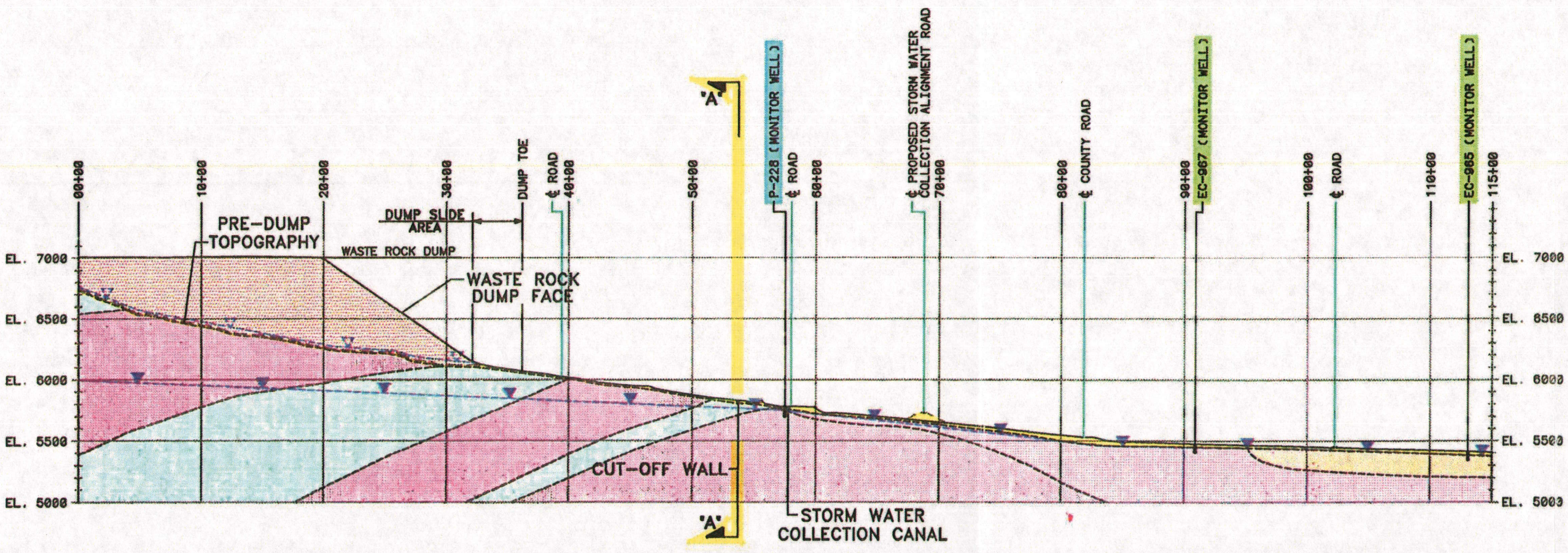

SECTION 'B-B'
LOOKING NORTH

NOTE

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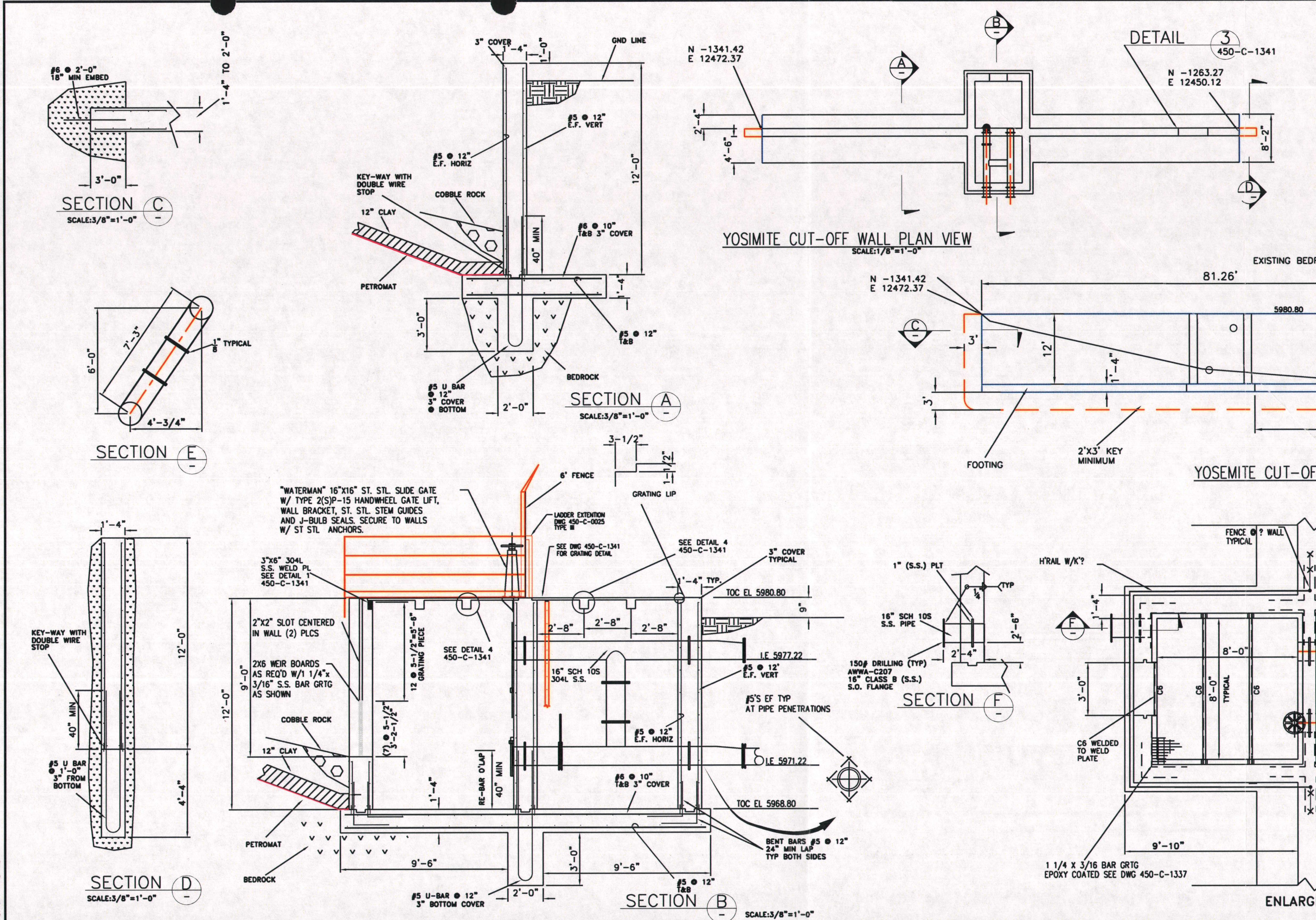
SCALE: 1" = 500'
BV/RKC
RKC
JFC

Attachment 6 – Supplemental Construction Drawings Related to Yosemite Runoff Control Facilities



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A	3/96	ISSUE FOR CHECK	MJL		

REFERENCE DRAWINGS	NUMBER
YOSEMITE CUT OFF WALL AREA PLAN	450-C-1337
YOSEMITE CUT OFF WALL PIPING AND GRATING DETAILS	450-C-1341
FLOUR DANIEL DAVY DWG.	500-24-004
FLOUR DANIEL DAVY DWG.	500-24-003
LADDER EXTENSION DETAILS	450-C-0025

ENGINEERING SERVICES

APPROVAL	DATE	SCALE: NOTED
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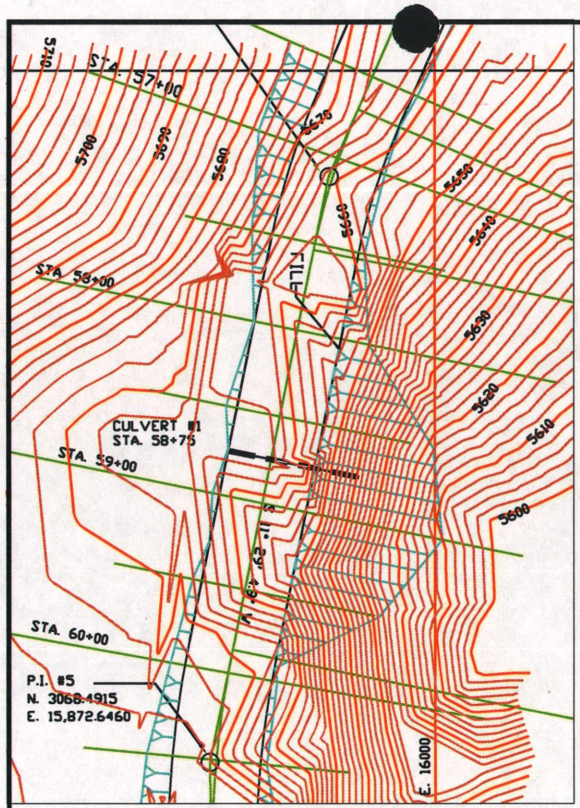
		DRAWN BY MJL
		CHECKED BY
		PROJECT ENGINEER MJL
		PROJECT MANAGER CM



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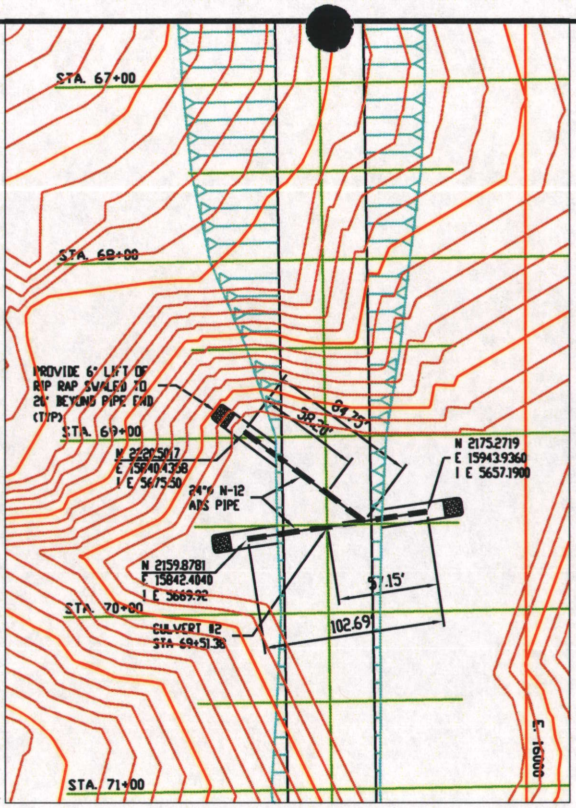

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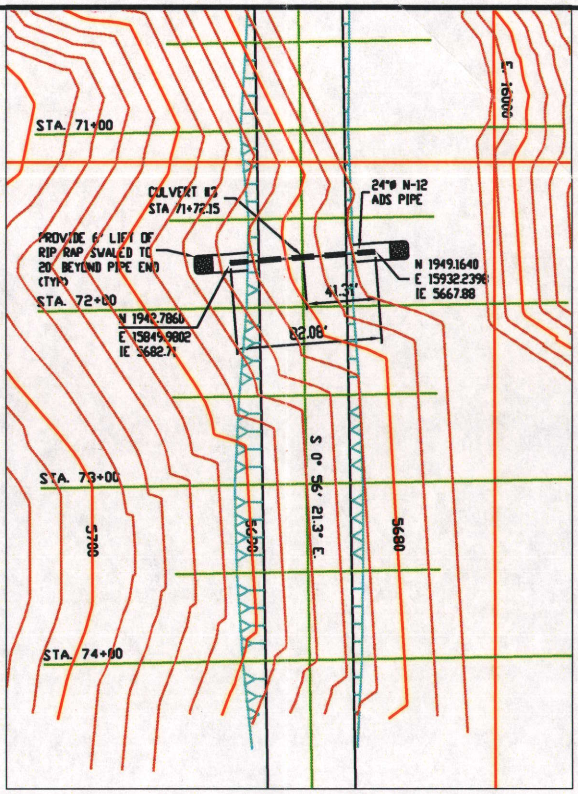

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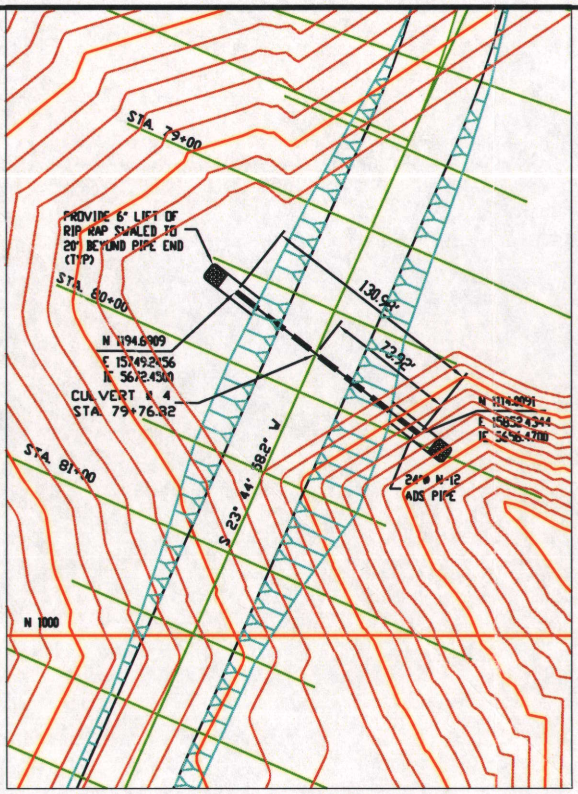

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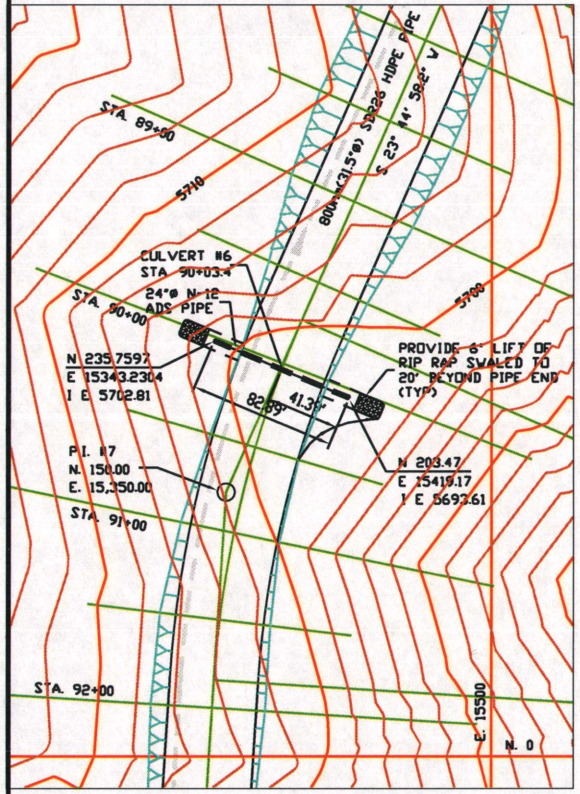

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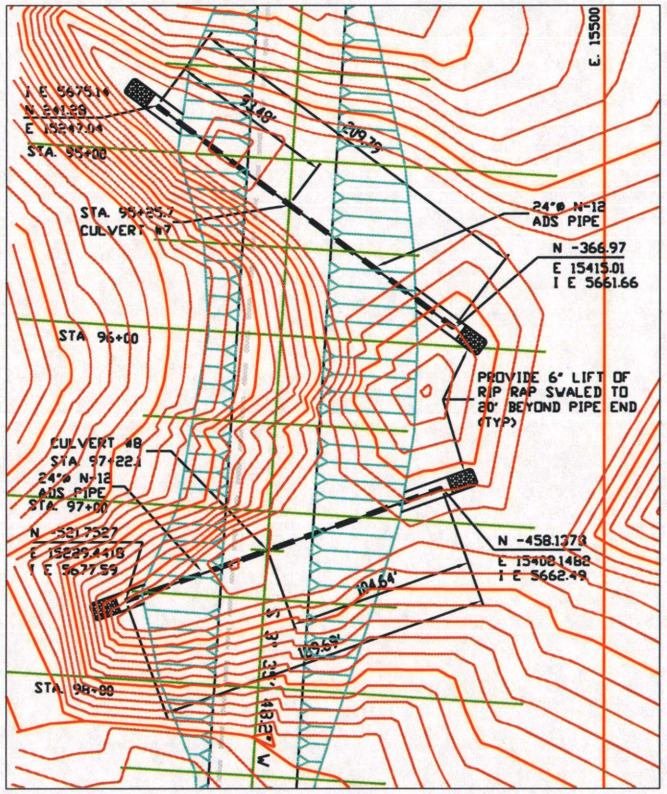
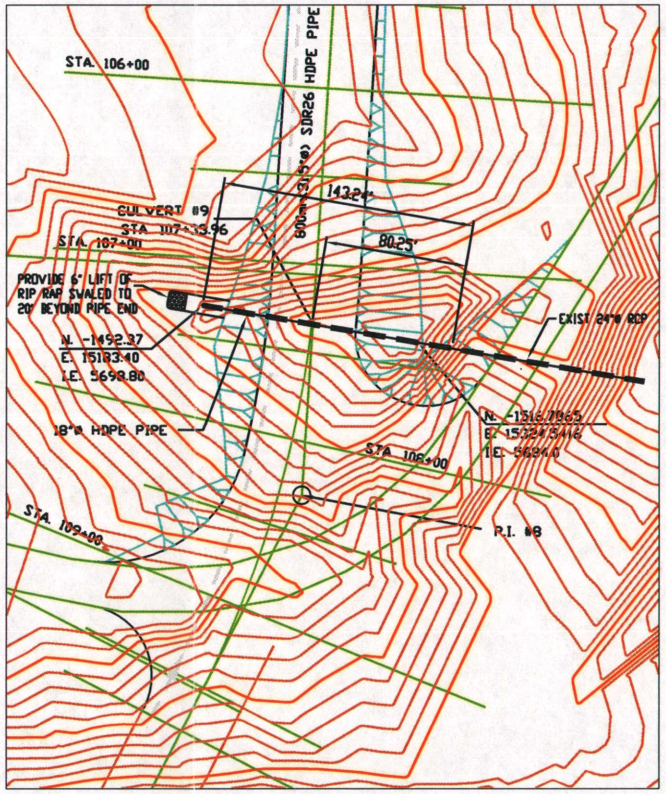


PLAN CULVERTS #7 & #8

(REF DWG 450-C-1441)



PLAN CULVERT #9

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A	5/17/93	ISSUE FOR CHECKING	EVH	VAC	RA

NO.	DATE	REVISION	BY	CHK	APP

REFERENCE DRAWINGS	NUMBER

REFERENCE DRAWINGS	NUMBER
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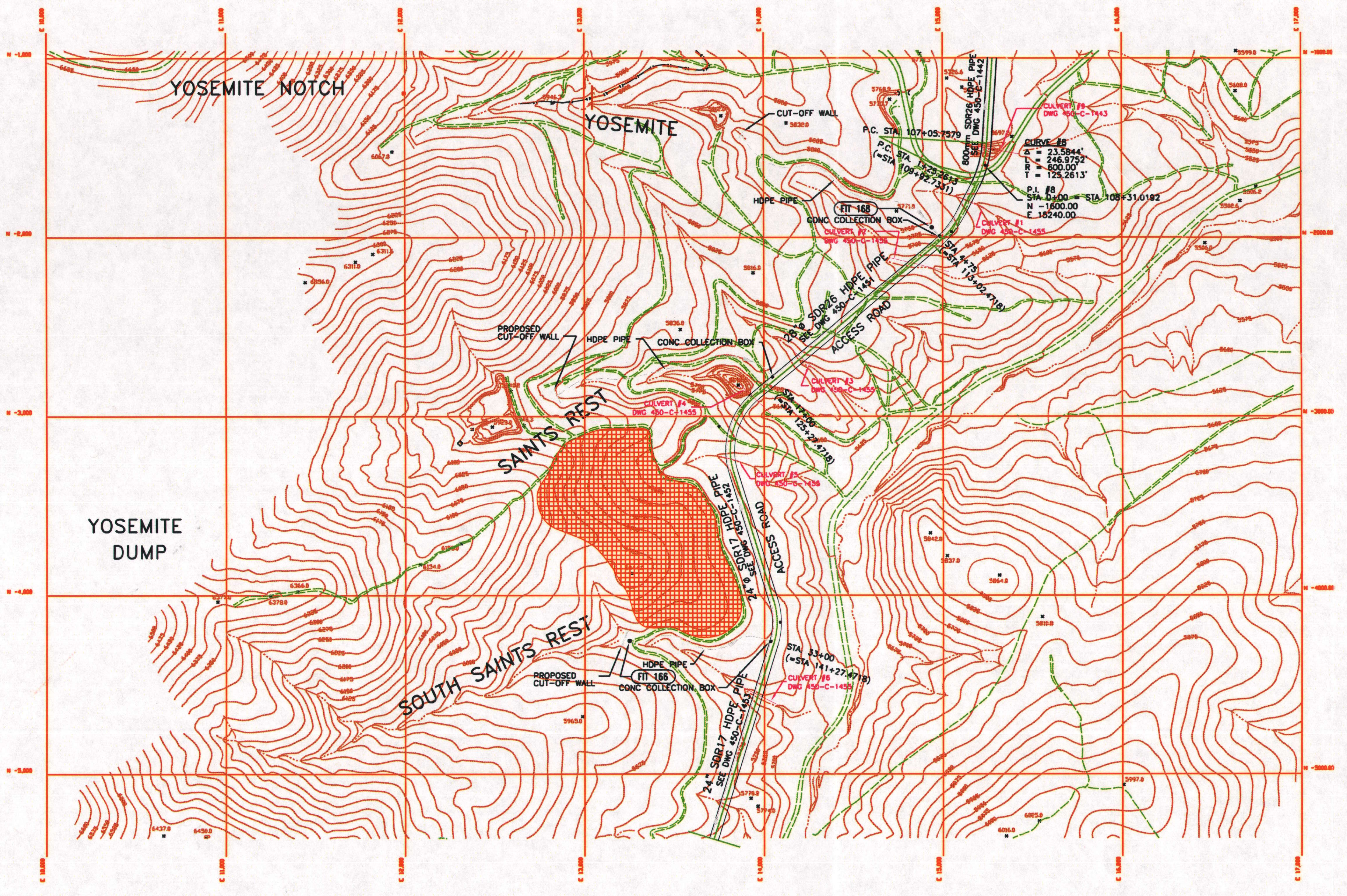
KEYSTONE TO COPPER STORM PLAN 3 OF 4	450-C-1441
KEYSTONE TO COPPER LEACH PLAN 2 OF 4	450-C-1440
KEYSTONE TO COPPER LEACH PLAN 1 OF 4	450-C-1439
YOSEMITE AREA GENERAL PLAN	450-C-1005
COPPER AREA GENERAL PLAN	450-C-1004

PLANT PROJECTS GROUP

APPROVAL	DATE		
		SCALE: 1"=50'	
R. ADAMS		DESIGNED BY	WAC
		DRAWN BY	EVH
		CHECKED BY	VAC/RA
		PROJECT ENGINEER	
		PROJECT MANAGER	



450-C-1005 10/07/93 17:07 KTHARDY

NO.	DATE	REVISION	BY	CHK	APP
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2	11/17/92	ADDED STORM SYSTEM INFO	EVH	RA	RA
1	8/12/92	ADDED YOSEMITE DUMP & NOTCH	WAC	RA	RA
0	7/16/92	ISSUED FOR ROAD CONSTRUCTION	WAC		

REFERENCE DRAWINGS	NUMBER
INSTRUMENT LOCATION PLAN	450-J-1000

REFERENCE DRAWINGS	NUMBER
YOSEMITE TO CASTRO STORM SYSTEM CULVERT DETS	450-C-1455
YOSEMITE TO CASTRO STORM SYSTEM PLAN 4 OF 4	450-C-1454
YOSEMITE TO CASTRO STORM SYSTEM PLAN 3 OF 4	450-C-1453
YOSEMITE TO CASTRO STORM SYSTEM PLAN 2 OF 4	450-C-1452
YOSEMITE TO CASTRO STORM SYSTEM PLAN 1 OF 4	450-C-1451
COPPER AREA	450-C-1004
CASTRO AREA	450-C-1006
OVERALL PLAN	450-C-1000

PLANT PROJECTS GROUP

APPROVAL	DATE	SCALE: 1"=300'	
R. ADAMS	12/2/92	DESIGNED BY	RA
D. WINTERS	12/2/92	DRAWN BY	WAC
L.J. WEEKS	1/11/93	CHECKED BY	RA
R. BURRIS	1/11/93	PROJECT ENGINEER	DRW
		PROJECT MANAGER	JLC

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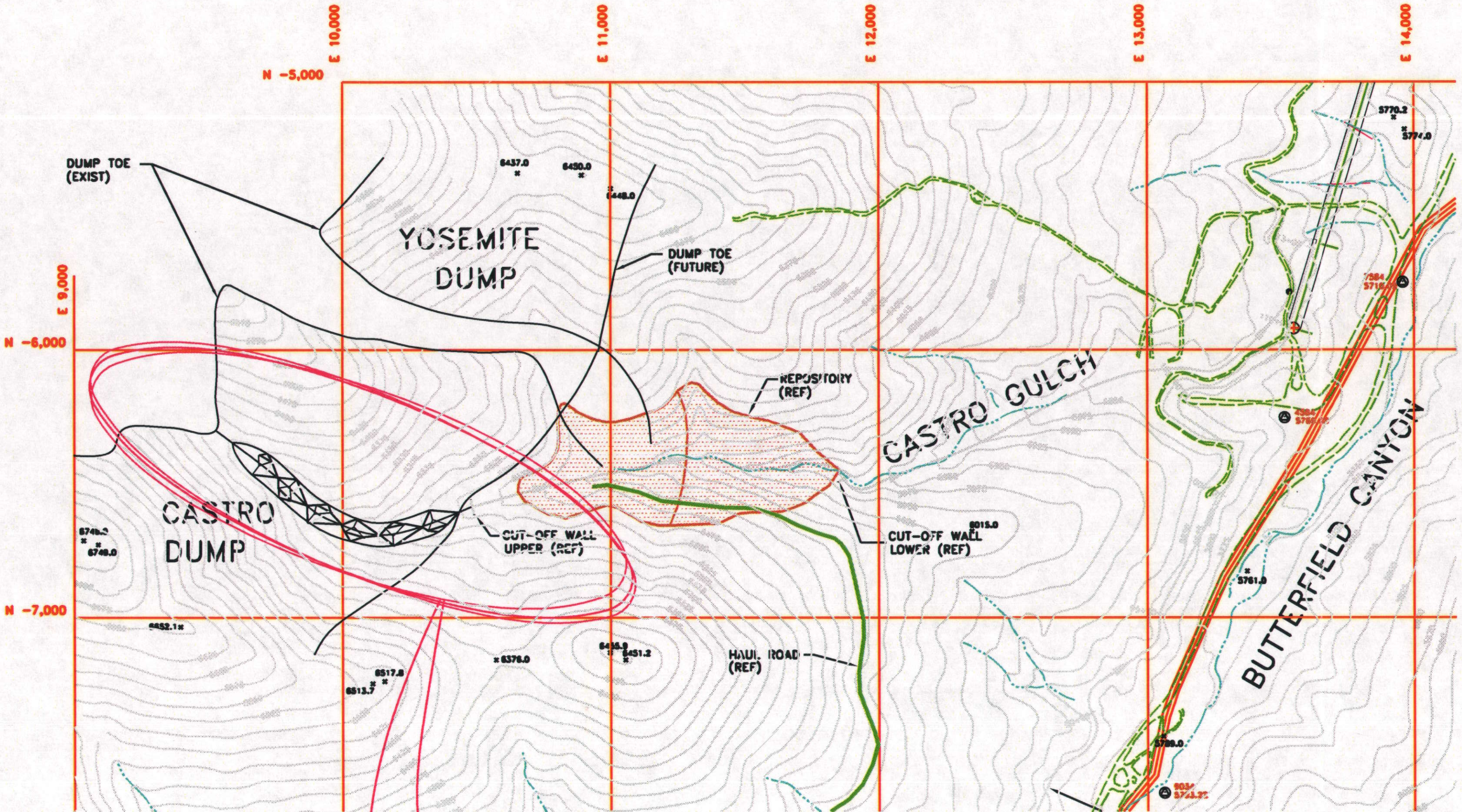
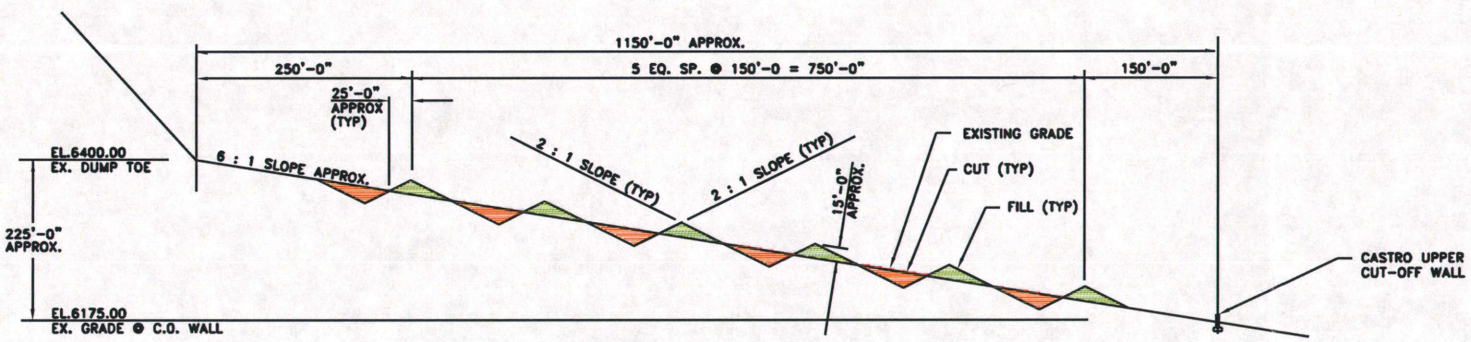


PLAN



PROFILE

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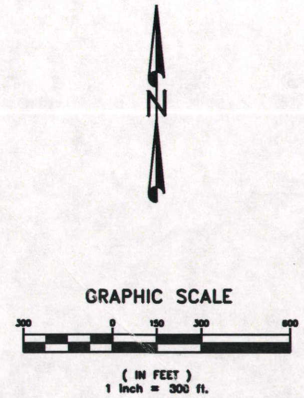

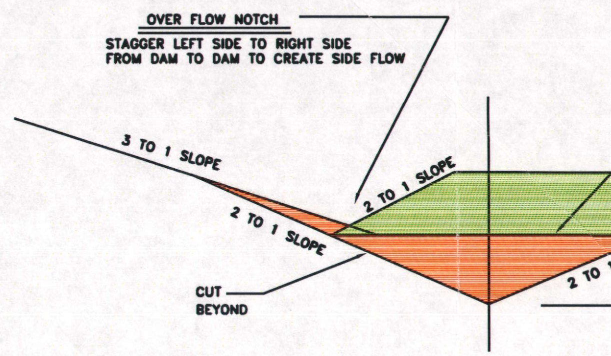

TYPICAL SECTION @ CENTER

SCALE: 1"=20'-0"

NOTES

1. TOPOGRA
AERIAL F
CO.)

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B	7/28/94	ISSUE FOR APPROVAL	RA												
A	6/22/94	ISSUE FOR REVIEW & COMMENT	RA												

ENGINEERING
SERVICES

APPROVAL	DATE	SCALE: 1"=300'
BVD	7/21/94	DESIGNED BY RA
RB	7/21/94	DRAWN BY RA
LJW	7/21/94	CHECKED BY RA
SMB	7/21/94	PROJECT ENGINEER
		PROJECT MANAGER